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A HISTORY OF FISHCULTURAL OPERATIONS IN CALIFORNIA.

By W. H. SHEBLEY, in charge Department of Fishculture.

The California Fish Commission was created by an act of the legislature, entitled "An act to provide for the restoration and preservation of fish in the waters of the state," approved April 2, 1870.

The United States Commission of Fish and Fisheries was established by joint resolutions of Congress, approved February 9, 1871. California, therefore, had an organized fish commission nearly a year before the federal government took up the work of multiplying the food fishes and thereby increasing the food resources of the United States.

The object of the first endeavors of the California Fish Commission was the introduction and acclimatization of new species of food and game fishes. As eggs could be obtained more easily than adult fish, suitable hatcheries for the hatching of eggs became a necessity.

ACCLIMATIZATION SOCIETY HATCHERY.

The California Acclimatization Society, under the supervision of Mr. J. G. Woodbury, first began experimenting, and had made several successful hatches of eggs introduced from the Eastern states previous to the establishment of a state fish commission. A small hatchery, situated near the City Hall in San Francisco, was utilized in this pioneer work.

STATE HATCHING HOUSE AT BERKELEY.

The first hatchery owned and operated by the state was situated on the grounds of the State University at Berkeley. Up to 1873 the Acclimatization Society actually operated this hatchery and was paid by the Fish Commission for the trout reared.

CLEAR LAKE EXPERIMENTAL HATCHERY.

In the early seventies, also, a temporary station was operated on Kelsey Creek, tributary to Clear Lake, for the purpose of hatching a shipment of whitefish sent to the California commission by the United

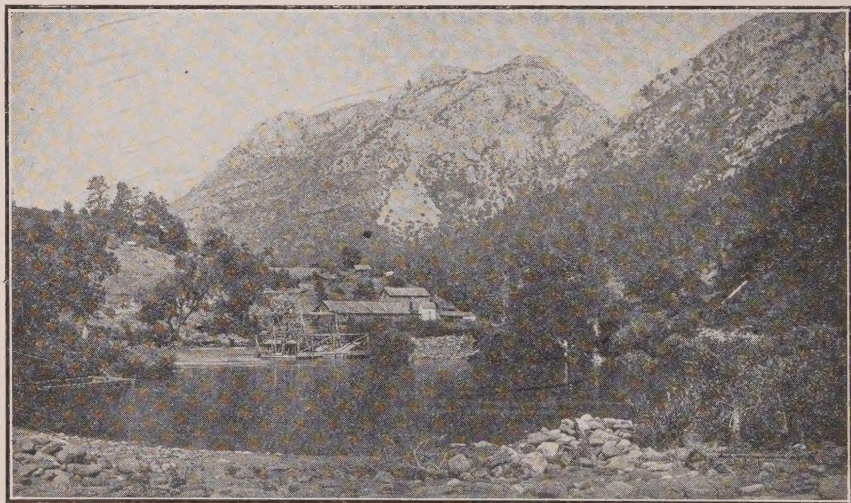


FIG. 32. United States Fish Hatchery at Baird, Shasta County, in July, 1882. This was for many years the most important salmon-egg collecting station in California.

States Fish Commission. Eastern brook trout, landlocked salmon and whitefish, as well as the native varieties, were propagated with some success, but the location was not suitable for carrying on the work on a large scale.

BAIRD HATCHERY.

The circumstances surrounding the establishment of the first salmon hatchery are as follows: In 1872 the United States commission instructed Dr. Livingston Stone to proceed to the Pacific Coast and there obtain a supply of salmon eggs from the Pacific salmon. Dr. Stone was at that time one of the recognized authorities on fishculture in the United States. He had been engaged in the work of fishculture

for a number of years in New Hampshire and other Eastern states, was a man of education and a close observer of all things in nature. Dr. Stone arrived in San Francisco in August, 1872. He could gain no reliable information regarding the habits of the Chinook salmon or where they spawned. A general impression prevailed that the spawning grounds were near the confluence of the Sacramento and San Joaquin rivers, but after an investigation of this region Dr. Stone concluded that the fish spawned elsewhere. Mr. Montague, chief engineer of the Southern Pacific Company, informed Dr. Stone that he had seen salmon spawning at the junction of the McCloud and the Pit rivers. At that time the terminus of the railroad was at Red Bluff, fifty miles from the spawning grounds on the McCloud River. Dr. Stone was accompanied on his trip to this section by Mr. John G. Woodbury, who had been in the employ of both the California Acclimatization Society and the California Fish Commission.

After many hardships and struggles to obtain material and supplies, they succeeded in establishing on the McCloud River the first salmon-breeding station on the Pacific Coast, naming it Baird, in honor of Spencer F. Baird, Commissioner of Fisheries. The summer run of salmon was nearly over and, judging from Dr. Stone's report, the salmon run in the Sacramento River was very much depleted. From the advent of the whites up to this time, there had been a great demand on the salmon of the Sacramento River; and with no hatcheries to increase their numbers, no adequate laws to protect the breeding fish (and with the great spawning grounds of the Feather, Yuba, Bear and American rivers destroyed by the mining operations on their headwaters), in a few years little was left of the great run of fish that had previously entered these waters. The salmon had abandoned them altogether, as the eggs deposited on the spawning grounds in these streams did not hatch, being destroyed by the detritus from the mines. The only natural spawning grounds left to the salmon were in the tributary rivers that formed the headwaters of the Sacramento River, the principal streams being Mill Creek, Battle Creek, Pit River and its tributaries, Hat Creek and the McCloud River, and the main Sacramento River, above the mouth of the Pit. These proved to be good salmon streams, but the great drain on the salmon and the destruction of nearly one-half of the spawning beds, soon greatly diminished their numbers.

The first season's operations on the McCloud River, by Dr. Livingston Stone and his assistants, were experimental to a great extent. Only 50,000 eggs were taken, and of this number but 30,000 were fit to ship when they had developed to the proper stage. The eggs were shipped to a hatchery in New Jersey and 7000 hatched; and on the advice of several state commissioners and fishculturists the fry were planted in the Susquehanna River. The following season the Baird Hatchery was enlarged and the work of collecting and hatching salmon eggs was begun in earnest. From 2,000,000 to 14,000,000 eggs were taken annually at this station from 1872 to 1883.

In 1881 the plant was destroyed by a freshet, but was immediately rebuilt. The California Fish Commission assisted in the work at Baird by paying a portion of the operating expenses, and in return received eggs for hatching and fry for planting. The main object of this

hatchery for the first few years was to secure eggs to ship to the East for the purpose of introducing Pacific salmon in the waters of that section. The commission early made an agreement with the State of California, however, under which the latter at first paid part of the expense, while the commission hatched and planted a portion of the take in the McCloud River. Later, part of the eggs were turned over to the state, which hatched and planted the salmon in local waters.

About 25 per cent of the total number of eggs taken during this time were hatched at this station, and the fry each season were liberated in the McCloud River, under the supervision of Dr. Stone, superintendent of the hatchery. The cost of hatching and planting was borne by the California Fish Commission. The remaining eggs were shipped to the Eastern states and to foreign countries. Shipments of the Chinook salmon were made to the principal countries of Europe and also to Japan and New Zealand.

In 1883 the United States commission quit operations on the McCloud River. Only 1,000,000 eggs had been taken during the season, this being the smallest take in the history of the work on this stream since the preliminary work of 1872. This great falling off in numbers was due largely to the heavy blasting and other operations on the line of the railroad which was then being constructed from Redding northward. The salmon undoubtedly were frightened so that they did not ascend the Sacramento River; besides, a great many were taken by the grading gangs and used in the camps for food. Thousands of trout and salmon were destroyed by powder used by the Chinese and white laborers, of whom there were 9000 camped along the Sacramento River; and while a great many of the fish were used as food, there was wanton destruction in the way they were killed. The same condition existed in 1884, and Superintendent Stone recommended that the station be not operated that season. It remained closed from that date until 1888, the year that the Sisson hatchery was established by the state.

SAN LEANDRO HATCHERY.

Finding the state hatchery house at Berkeley too small for the quantities of fish required to be hatched, as well as lacking in a reliable water supply, a larger hatching house was built on Lake Chabot, on the property of the San Leandro Water Works, near San Leandro, California, in 1878. Here much of the trout work was carried on until the Shebley Hatchery in Nevada County was taken over by the state.

SHEBLEY HATCHERY.

In 1883 the California Fish Commission abandoned the San Leandro Hatchery, located near Lake Chabot in Alameda County, owing to the fact that the water was too warm for successful hatching and rearing to be accomplished during the warmer months of the year; also, the water was not suitable for the propagation of healthy fry.

A site was selected in Nevada County on the ranch of Mr. J. V. Shebley, who donated to the state the use of the site and the water for hatchery purposes. The first superintendent was Mr. J. A. Richardson, a fishculturist formerly employed by the United States commission

at Baird, and by the California Fish Commission, as an assistant to Mr. J. G. Woodbury at the San Leandro Hatchery.

The work accomplished at the Shebley Hatchery was limited, owing to the small amount of money appropriated and the great cost of transporting the fry to the waters to be stocked. The commission had to pay expressage on all shipments of eggs and fry distributed. The principal work was the hatching of rainbow trout, the black-spotted trout of the Tahoe basin, and also a number of shipments of eastern brook trout and landlocked salmon. This hatchery was operated until 1888, when the board decided to establish larger hatcheries located near the egg-collecting stations, where an unlimited supply of water could be had. Accordingly, in 1888, after the distribution of fry was over for the season, the Shebley Hatchery was abandoned, and in the following spring the tools and apparatus that were the property of the state were shipped to the new hatchery on Lake Tahoe, at Tahoe City.

FRAZIER HATCHERY.

Frazier Hatchery was established in 1875 by I. C. Frazier, on Squaw Creek, Nevada County, under permit and authority granted by the State Fish and Game Commission. This hatchery was operated until 1880, when it was abandoned.

HURLEY HATCHERY.

The Hurley Hatchery was established in May, 1880, by John Hurley under permit from the Fish Commission. During that year there were hatched and distributed over 95,000 trout. Captain Todman, with the authority of the commission, leased the hatchery and hatched and released over 500,000 trout during the year 1887. The commission in 1888 took over the hatchery, and before the end of June had hatched and distributed over 600,000 trout.

HAT CREEK HATCHERY.

In 1885 the California Fish Commission decided to establish a hatchery for the propagation of salmon, as the federal government had not again resumed operations at Baird, on the McCloud River. After examining a number of sites, it was decided to establish a hatchery on Hat Creek, with the exception of Fall River the largest tributary of the Pit. Hat Creek is a large stream, carrying about 26,000 miner's inches of water, and is not subject to sudden floods. The commission had the plans of the hatchery made after the design of the old Baird Hatchery and let the work out by contract. The hatchery was a large building for those days; it was constructed of good material, was 100 feet long, 46 feet wide, and contained 64 hatching troughs when completed. It had a capacity of 90 troughs, but all were not put in, as the run of salmon did not justify the expense. There was a complete filtering plant and the hatchery was fully equipped to care for from 6,000,000 to 10,000,000 eggs. The year following its completion, Mr. J. V. Shebley took charge of the station. He began operations early in August, but although trapping and seining for the spawning salmon



FIG. 33. W. H. Shebley and H. E. Southern examining Klamath River trout on Cottonwood Creek, near Hornbrook, Siskiyou County, about 1904.

was continued until November, only 1,200,000 eggs were collected. The spawning beds that a few years before had been covered with thousands of spawning fish were now deserted. In 1887 W. H. Shebley was appointed superintendent of the Hat Creek station, to succeed J. V. Shebley, who resigned from the commission to engage in private business. The take of eggs the second year was less than that of the first. Every effort was made to procure sufficient eggs to justify the commission's operating the plant, but only 500,000 were taken.

In the spring of 1888 Superintendent W. H. Shebley recommended to the Board of Fish Commissioners and to Governor Waterman that the Hat Creek Hatchery be either abandoned or closed down for a number of years, and that a station be established lower down the river at a place where the salmon eggs could be collected and shipped to a hatchery along the line of the railroad. It was demonstrated beyond any doubt, during the two seasons that Hat Creek station was operated, that the spawning salmon did not reach Hat Creek, nor the Pit River near its confluence with Hat Creek, in numbers sufficient to justify the expense of operating the station any longer. In former years a large run of salmon ascended Pit River as far as the falls below the town of Fall River Mills, and also into Hat Creek; but owing to the diminishing number of salmon in the Sacramento River and its tributaries, the fish that ascended the river found ample spawning beds lower down, near the confluence of the Pit, the Sacramento and the McCloud rivers. The board, acting on this recommendation, ordered the hatchery closed and began looking for another site.

MOUNT SHASTA HATCHERY.

In August, 1888, Mr. J. G. Woodbury was appointed superintendent of hatcheries of the California Fish Commission. He immediately began to look for a suitable location for a large hatchery along the line of the railroad, at the headwaters of the Sacramento River. After making a thorough examination and a study of the conditions of the different streams, it was decided to locate the hatchery on Spring Creek, near the town of Sisson, on the property of Mr. J. H. Sisson. Spring Creek has its source in a large spring about a mile from the hatchery; the water is pure and cold and its temperature does not vary to great extremes. The good judgment shown by Mr. Woodbury and Dr. Stone in selecting this location has been proved by the successful work done at Sisson during the ensuing years.

The first hatchery on this site was built in the fall of 1888. It was a plain wooden structure 40 by 60 feet, containing 44 troughs, and was hurriedly constructed to accommodate the eggs that were being collected by the United States commission at Baird from the fall run of salmon in the McCloud River; for the federal commission had resumed operations on the McCloud River, after having closed the station for five years. An agreement had been entered into whereby the United States commission and the California commission were to divide the work of propagating salmon in California; the former was to collect and prepare the eggs for shipment, the latter to hatch and distribute them.

The Sisson Hatchery was completed and ready for operations in September, 1888. The floods did not interfere with the work, and Dr. Stone operated until late in November. Eight hundred thousand eggs were collected from the early fall run and 2,200,000 from the October and November, or late fall run. These eggs were hatched and the fry fed until they were large enough to care for themselves and then carefully distributed in the upper reaches of the Sacramento River and its tributaries.

The policy of feeding the fry was continued until 1895, when it was discontinued by the Board of Fish Commissioners as a matter of economy coupled with a wrong idea that had been advanced by those who were dictating the policy of the fishcultural operations in California



FIG. 34. The old Sisson Hatchery in 1894.

that the salmon fry were better off if distributed as soon as the umbilical sac was absorbed. The benefit of feeding the fry was plainly demonstrated by the great increase of the salmon in the Sacramento River in the years that followed the return of the output of fry from 1888 to 1896.

The fry at the Mount Shasta Hatchery are first held and fed in the troughs about two months before they are removed to the ponds. Then they are taken out in small lots and fed until all are accustomed to the new surroundings. The pondkeeper distributes the food slowly at the different feeding stations in the ponds, until he is satisfied that all the fry have received their share of food. By this method the fry all make the same development and growth, and there is no danger of developing a lot of precocious fry to exercise their cannibalistic instincts on the others.

In 1911 it was decided to again hold and feed the salmon fry until they were large enough to care for themselves when distributed, as well as to hold a large number of them in the ponds at the Mount Shasta

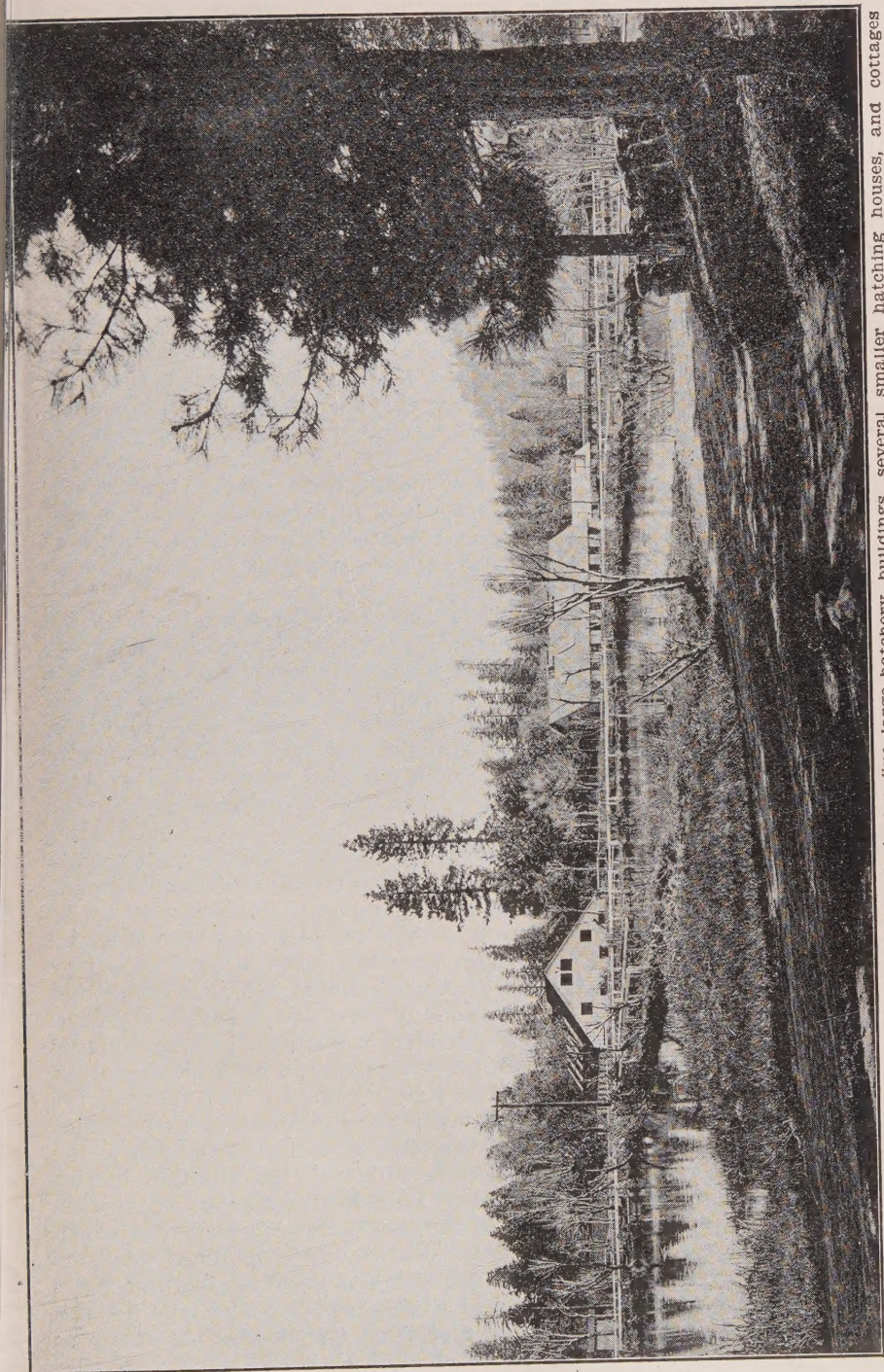


FIG. 35. Sisson Hatchery in 1916. On the grounds are five large hatchery buildings, several smaller hatchery houses, and cottages for employees.

Hatchery until fall and then release them in the upper reaches of the Sacramento River during the early fall, before the winter floods. During the season of 1913 three quarters of a million salmon fry were held in the ponds at this hatchery and released during October. During the season of 1914, 21,000,000 salmon fry were held in the troughs, nurseries and ponds and fed until late in the spring. Of this number, 4,000,000 were placed in the large ponds at the Mount Shasta Hatchery in perfect condition, where they were fed daily and looked after by skilled fishculturists until the early fall, when they were released, so that their descent of the river might be less hazardous and a greater number might reach the ocean than is the case with the fry released in the spring or summer. This policy of holding and feeding all of the salmon fry before releasing them, and then only when the flood season is over in the spring, has unquestionably given good results. It is believed that it was the holding and feeding of the fry in the early history of the Mount Shasta Hatchery that increased the run of salmon in the Sacramento River, and that the present run is largely due to these efforts.

During the year 1913 three new ponds were constructed for the rearing of brood fish, making in all a total of fifty-one ponds and nurseries. With the increasing demand for fish to stock streams, it was found necessary to increase the pond system sufficiently to raise enough stock fish to supply the eggs.

Located as it is at an altitude of 3500 feet above sea level, on the southern slope of Mount Shasta and in the heart of Strawberry Valley, with a wonderful supply of pure cold water, within a mile of the main line of the Southern Pacific Railroad and but a couple of hours by rail from the rainbow trout egg-collecting stations on the Klamath River, Mount Shasta Hatchery is ideally situated. It not only has a capacity for handling the bulk of trout fry, but is also capable of rearing a sufficient number of salmon fry to maintain the salmon run in the Sacramento River.

The development of this hatchery from a small salmon hatchery to its present size has been gradual. Each year permanent improvements have been made. From the first small permanent building, 40 by 60 feet, containing 44 troughs, erected in 1888, the plant has been enlarged until at the present time it includes seventeen acres of land owned by the state, with a water right of 700 miner's inches; fifty-one ponds and nurseries for the rearing of thousands of fish; five hatchery buildings containing 450 troughs; a superintendent's residence; three cottages for the foreman and assistants; a spawning house; a barn, sheds, garage and other buildings, and an electric lighting plant. The value of the lands and improvements, together with the apparatus and equipment necessary to maintain a station of this size, estimated at the cost of the purchase price and of construction, is \$100,000. In addition to this equipment, the commission has leased outside the grounds but within a radius of a quarter of a mile of the plant, three large ponds which are used for rearing salmon fry. The capacity of these ponds is 3,000,000 fry. A one and a half-ton truck is used for hauling materials and supplies from the town of Sisson, which is one mile distant, and for hauling fish and eggs to and from the trains. As many as

100,000 fish are retained in the fifty rearing ponds as breeders. Ten to thirty million trout and salmon are hatched and reared at the station each year.

MILL CREEK AND BATTLE CREEK HATCHERIES.

The work of collecting salmon eggs has been systematically carried on by the joint operations of the federal and state commissions, with the object of increasing the number of salmon in the Sacramento River. Two hatcheries have been established for the work, one at Battle Creek, in 1895, by the state commission; the other at Mill Creek, in 1902, by the federal commission.



FIG. 36. The first salmon-egg collecting station on Battle Creek in 1905. In the first year of operation the take amounted to ten million salmon eggs.

The Battle Creek Hatchery has proved to be one of the greatest salmon-spawning stations in the world, as many as 60,000,000 eggs having been taken in one year. It was largely due to the efforts of Mr. John P. Babcock that this fine station was located. He had taken a keen interest in the propagation of salmon and recommended this site to the California Fish Commission. Battle Creek is one of the large tributaries of the upper Sacramento River; it rises in the watershed of Mount Lassen and flows into the Sacramento River about twenty miles north of Red Bluff. There is a lagoon two and a half miles long at its mouth, in which the fall-run salmon gather in thousands. The California Fish Commission operated this station for two years, but owing to a lack of funds, and desiring to see the station operated to its fullest capacity, a proposition was made by the state commission to Hon. J. J. Brice, then United States Commissioner of Fisheries, to purchase the plant for a government station, the money thus obtained to be applied

to increasing the capacity of the Sisson Hatchery. Commissioner Brice accepted the proposition and laid the matter before Congress, and the necessary appropriation for purchasing the station was made. The eggs collected at this station, as well as at the other federal stations in the state, have been largely turned over to the California commission for hatching and distributing. During the two years that the Battle Creek station was operated by the California commission, Messrs. E. W. Hunt, superintendent of the Tahoe Hatchery, and W. H. Shebley, superintendent of the Sisson Hatchery, cooperated in the immediate supervision of the work.

The salmon have gradually increased as the result of artificial propagation and the protection of the spawning salmon on their way to the breeding grounds at the headwaters of the Sacramento River and its tributaries. As an illustration of the wonderful results obtained, the United States commission collected and shipped to Sisson from the summer run of 1888 but 800,000 eggs, and 2,000,000 from the late fall run. With this small beginning, the great work of restocking the Sacramento River gradually increased until, during the season of 1905-1906, the federal Bureau of Fisheries collected 100,000,000 salmon eggs at the three stations—Baird, Mill Creek and Battle Creek. During the season of 1903-1904, there were hatched at the Sisson Hatchery 58,000,000, and in the season 1905-1906, 96,000,000 salmon eggs. This great work was made possible by the construction of batteries of troughs outside of the buildings, in which to hatch the surplus eggs, the nurseries being used to rear the fry, as they could not be held in the troughs until large enough to be liberated.

MILL CREEK EGG-COLLECTING STATION.

This station is the property of the federal bureau, but was operated in 1912 by the California commission. Theretofore the salmon eggs had been hatched largely at Sisson, and as the prospects were unusually promising for the previous season it was feared the capacity of the Sisson Hatchery would be overtaxed. Accordingly, arrangements were made with the federal bureau whereby the state operated the Mill Creek station.

During the year 1902 a substation was established on Mill Creek, a stream which has its source in the foothills of the Sierra Nevada Mountains, in the northeastern part of Tehama County, and empties into the Sacramento River from the east about a mile above the town of Tehama. The eggs were retained here until eyed, and then were shipped to other hatcheries.

REDWOOD CREEK AND KORBEL HATCHERIES.

Continuing to increase their salmon operations, the United States Fish Commission in 1889 erected a salmon hatchery at Fort Gaston, in the Hoopa Indian Reservation in Humboldt County. An additional egg-collecting station was established on Redwood Creek in 1893, and the same year a new hatchery was built near Korbey, on Mad River, but on account of inaccessibility, all three stations were abandoned in 1898.

LAKE TAHOE HATCHERY.

In the spring of 1889 Superintendent Woodbury, acting under instructions from the Board of Fish Commissioners, decided to locate a permanent hatchery on Lake Tahoe. The state had been carrying on hatchery operations under the direction of Mr. I. C. Frazier, in a rented building that was not properly equipped to do good work. Each season a few hundred thousand eggs had been taken from the black-spotted trout of Lake Tahoe and shipped to the Shebley Hatchery in Nevada County, and when the fry were hatched they were shipped back to the Truckee and Tahoe region and distributed.

After a study of conditions the hatchery was located near Tahoe City, at the north end of the lake. The water supply was furnished from springs rising on the land used as a hatchery site. Thirteen acres were first rented, but later purchased so as to secure all the available water to be had near the site. At this hatchery millions of black-spotted trout were annually reared until 1916.

During the season 1891 the Tahoe Hatchery, as well as the other hatcheries, was not operated, owing to dissension among members of the board. Three private hatcheries, located at Del Monte, Glen Ellen and Alma, were supervised by the state for a few years, but the resulting hatch was negligible. In 1892 the Sisson Hatchery was reopened but the Tahoe Hatchery was not reopened until 1894, when Mr. E. W. Hunt was appointed superintendent. The work of propagating the black-spotted trout of Lake Tahoe was systematically taken up by Mr. Hunt, and the increased number of fish in the Tahoe region is evidence of his energetic and intelligent work. The increase of trout in Lake Tahoe, like the increase of salmon in the Sacramento River, is well demonstrated by the work of the egg-collecting stations. In 1890 the commission seined on all the available places in the lake where it was thought spawning fish could be taken, besides operating traps in three of the best creeks flowing into the lake, and only 873,000 eggs were procured. In 1910, 6,000,000 were taken at the Taylor Creek egg-collecting station alone.

THE NEW LAKE TAHOE HATCHERY.

By 1916 it had become more and more evident that the supply of water at the old site of the Tahoe Hatchery was entirely inadequate. Consequently, during the fall of 1917, a survey was made of all the available and suitable streams flowing into Lake Tahoe, and after a careful examination a site was selected at Walker Springs, one mile north of the present site, on the state highway. The Walker Springs run, during the minimum flow, 30 inches of water, and during the maximum flow a couple of hundred inches; and this during the season of greatest hatchery activity. Therefore the state secured a most desirable site to carry on hatchery work, and the only suitable water for hatchery purposes in the Tahoe Basin proper. The streams that have their sources in the mountain range surrounding Lake Tahoe carry too much detritus and are too roily during the time the snow is melting. After purchasing the property, plans were made by the state architect for a modern stone hatchery with four times the capacity of the old



FIG. 37. (Above) The old Tahoe Hatchery as it appeared in 1906. (Below) The new Tahoe Hatchery completed in August, 1920.

hatchery. The contract was given to Mr. Matt Green during the summer of 1919. Work was begun on the new hatchery that fall and was completed in the fall of 1920.

The new hatchery contains 64 troughs and has a capacity of about two and a half million trout. Provision has also been made for breeding ponds and nursery ponds and a superintendent's cottage. This new hatchery was made the more necessary because of the lack of water at the Tallac Hatchery during the past few years. The new Tahoe Hatchery is of sufficient size to handle practically all of the black-spotted trout operations.

At the request of Governor Stephens and the citizens of Placer County, the old hatchery grounds were converted into a public camping ground by an act of the legislature during 1918, and the management of this public park was placed with the Fish and Game Commission, which has improved and maintained it from the funds collected from hunting and angling licenses.

MOUNT TALLAC HATCHERY.

In 1895 Lawrence and Comstock erected a temporary hatchery near Tallac, about two miles from the mouth of Taylor Creek, and placed it under the control of the commission. The following year operations were moved to Tallac Creek. For a number of years a good proportion of the eggs taken in the vicinity were hatched at this station and distributed in the public waters of that region. However, owing to the distance from the spawning grounds and the small supply of water, it was decided in the fall of 1908 to abandon this hatchery and erect a substantial modern building on Taylor Creek near Tallac, where a large supply could be obtained and where the work of hauling the eggs to the hatchery in the early spring, when the country is covered deep with snow, would not be so difficult. After securing a lease for a term of years from Mrs. Anita M. Baldwin, the new building, 40 by 70 feet, was erected. It has a capacity of 3,000,000 eggs and is splendidly equipped. Since a dam was erected on the stream above the hatchery, however, water conditions have not been so good.

GLEN ALPINE HATCHERY.

Through the joint efforts of Mrs. George Pierce of Glen Alpine Springs, and Professor W. W. Price of Alta, a small hatchery was completed at Glen Alpine in 1905 and was operated as an auxiliary to the other two Tahoe stations until 1912. It was only a small building, the property of the Glen Alpine Hotel Company, having a capacity of 1,000,000 eggs, and was used by the commission to hatch out a few hundred thousand eggs to save the cost of transportation of the fry.

BEAR VALLEY HATCHERY.

To satisfy the feeling of necessity for a hatchery in the vicinity of San Francisco, and after careful examination of the waters of the neighboring counties, Bear Valley, in Marin County, was finally selected as the site for this hatchery, which was erected in the fall of 1891. It was operated as a trout station during the seasons of 1892 and 1893, but was closed for trout work in 1894. Owing to the limited supply of

water and the great distance from the railroad, it was considered neither economical nor expedient to operate this station longer. The efforts of the board were to concentrate the principal trout work at Sisson, aside from the work done at the Tahoe Hatchery for the propagation of the black-spotted trout of that region.

WAWONA HATCHERY.

In 1895, under the supervision of W. H. Shebley, a small hatchery was erected at Wawona, to provide fish for the lakes and streams in the Yosemite Park and adjacent country. The hatchery was erected and equipped by the Yosemite-Raymond Stage Line and turned over to the commission to be operated upon condition that an annual hatch of 500,000 trout eggs should be distributed in that vicinity. It was managed for a number of years by Mr. M. L. Cross, who was remarkably successful in the work, principally that of hatching rainbow trout eggs and eggs of the black-spotted trout of the Tahoe Basin. The eggs were shipped to this station, and the fry distributed throughout the lakes and streams of Yosemite National Park and the surrounding country. The German brown trout also has been distributed in a number of the lakes and streams, and has done remarkably well.

By 1916 the hatchery and equipment had become so old that operations were suspended. In 1918, however, a new hatchery was constructed on the old site and the old equipment temporarily installed. Later the newer equipment from the Yosemite experimental hatchery was substituted.

PRICE CREEK HATCHERY.

In its endeavor to increase the salmon supply in California the commission investigated conditions on Eel River, and in 1897 a hatchery was erected on Price Creek, one of the tributaries of Eel River, about twelve miles from its mouth.

The first eggs were shipped from Battle Creek to the new station in December of that year. This station proved to be a great success. Eel River, like the headwaters of the Sacramento, has no predatory fish except the trout to devour the salmon fry. The water of the river from the mouth of Price Creek to the ocean flows through deep pools, with very little current. The salmon fry find perfect conditions in this stretch of water, and enter the ocean with very little loss and in fine condition. This station has also been used for collecting and hatching steelhead eggs for distribution in the streams in Humboldt County. The increase of salmon in Eel River, following the establishment of this station, is another example of the benefit derived from artificial propagation. At the time the first salmon fry from the hatchery were liberated in Eel River during the spring of 1898, the average annual shipment of salmon from Eureka was about 500,000 pounds. After the establishment of the hatchery there was a steady increase, and in 1904 the shipment was over 1,500,000 pounds.

A most remarkable example of artificial propagation of salmon is shown at this important station. This hatchery, in Humboldt County, was established in 1897, at which time the average number of pounds

of salmon shipped from Eureka per year was less than 500,000. In 1899, 470,806 pounds were shipped from this territory. Five years later, 1904, the total number of pounds had increased to 1,877,000.

In 1902 this hatchery made the first plant in the state of steelhead trout fry. After the spring of 1906, when the restriction prohibiting netting became effective, there was a marked increase apparent. In operating one small trap on Price Creek (which was at different times flooded) the largest number of steelhead eggs ever taken in Humboldt County was secured. In 1916 the hatchery was moved to a point on Eel River near Fort Seward.

UKIAH HATCHERY.

During the season of 1897 Mr. A. W. Foster, president of the San Francisco and North Pacific Railroad Company, being desirous of adding to the attractions of the streams along the line of his road by thoroughly stocking them with fish, caused to be built at Ukiah a fish hatchery having a capacity of 2,000,000 eggs, and arranged with the commission to supply the hatchery with trout spawn, upon an agreement from him that the fish should be planted in public waters. Mr. Foster employed competent men to operate the hatchery, and in the spring of 1897, 700,000 trout eggs were forwarded to the Ukiah Hatchery. They were there successfully hatched and afterwards liberated in the public streams of Marin, Sonoma and Mendocino counties. In the spring of 1898 the commission forwarded to Ukiah 200,000 eggs. The number was reduced because the water supply of the section was affected by the dry season. The addition of this hatchery has been and will continue to be of great assistance in stocking the 1200 miles of trout water in these counties.

In 1911 the Fish and Game Commission took over complete control of the Ukiah Hatchery, since which date it has continued operations. Several years ago improvements were made at the station in order to permit the eyeing of all the steelhead trout eggs taken at the Snow Mountain station.

MEARS AND HAZEL CREEK STATIONS.

During the early part of 1898 the commission caused traps to be placed in Mears and Hazel creeks, tributaries of the Sacramento River, near Sims, hoping to increase the output of rainbow trout. Owing to the lack of rain these creeks did not rise and the usual run of spawn fish did not attempt to ascend them, and the project was a failure. The location, however, was considered good, and the effort was renewed the next year, but as the second attempt was also a failure it was considered wise to abandon the location and try a point on the Truckee.

The expense of the work at Sims was borne by the Southern Pacific Company.

VERDI EGG-COLLECTING STATION.

Following the failure of the attempt to take trout spawn from the Sacramento River, and still desiring to increase the output of rainbow trout fry, a point on the Truckee River known as the Essex dam, near

Verdi, Nevada, was selected, where in 1902 a cheap building was constructed and fitted up as a hatchery to hold the eggs until such time as they could be shipped to Sisson and Tahoe. The lease for the land used was donated to the board by Mrs. Margaret Foulkes of Verdi, Nevada.

The spawn fish were collected from the river by means of traps placed near the fishway on the dam, directly in front of the hatchery building.

The run of rainbow trout at this point was an agreeable surprise, and was made possible by the action of all the owners of dams in the river in Nevada in placing fish-ladders on the dams and by the efforts of the peace officers of Nevada, who enforced the closed season. The Truckee River rises in California, its head being in Lake Tahoe. It passes for many miles through the mountains of California and then runs into Nevada, emptying into Pyramid Lake, so that both Nevada and California are intimately concerned in any action that will lead to the betterment of the fishing interests of this river.

The authority for operations at this point was granted by the county commissioners of Washoe County, Nevada, who appreciated the fact that California and Nevada are jointly interested in improving the fishing conditions of the Truckee River. In addition to granting this authority, the commissioners exercised their power to have the laws enforced in Nevada. Between the last of February and the first of May 538,000 rainbow trout eggs were taken. In addition 500,000 black-spotted trout eggs were taken; for lack of hatching room, however, all but 218 black-spotted trout were liberated in the river above the traps. The total number of eggs collected at the station the first year was 1,038,000, part of which were shipped to the Sisson Hatchery and part to the Tahoe Hatchery, the balance being hatched and liberated in the Truckee River near Verdi, in Nevada.

So far as trout propagation is concerned, there is no stream so naturally prolific and so responsive to propagation and protection as this mountain stream. The take in the spring of 1904 was most discouraging, although the prospects were good. There were large numbers of good-sized fish to be seen, but the heavy and continuous storms kept the Truckee River at a flood stage for several months. The gates at the outlet of Lake Tahoe, which had been closed during the summer of 1903, had stored the water to a higher level than usual. This was quickly raised by the heavy rain and melting snow until it became necessary, in order to save the property around Lake Tahoe, to open the flood gates to their full extent. The continuous flow of such a large volume carried away dams and swept a great deal of heavy debris down the river, taking out racks and traps and making it impossible to replace them. The failure to make a good collection was due solely to the unusual conditions, the total take being about 75,000 eggs, 35,000 of which were eyed and sent to the United States Fisheries station at Leadville, Colorado. About 30,000 fry were hatched at Verdi and liberated in the waters of the State of Nevada.

In 1905 the station was discontinued, the Truckee River continuing at such a height that the capture of spawning fish was not feasible with the equipment at hand. The funds of the commission would not allow a permanent barrier or trap; at least, the number of eggs collected did not justify the expense at that time. The hatchery supplies were sent

to the stations on Lake Tahoe and at Sisson; the hatching troughs and other material too heavy to transport were donated to the State of Nevada, and have done some excellent service.

HORNBROOK EGG-COLLECTING STATION.

After a favorable report on the possibilities of taking rainbow trout spawn from Cottonwood Creek, Siskiyou County, had been made by W. H. Shebley, superintendent of Sisson Hatchery, in 1900, the board secured permission from Mr. David Horn, who owned the land on both sides of the creek, to trap the fish on his land and to make the necessary preparations to that end by constructing a temporary egg-collecting station. Accordingly, in January, 1901, operations were commenced by putting in a rack and large trap, also fitting up troughs in a tent for the purpose of eyeing the eggs before shipment to Sisson. It was found later, however, that the water supply taken from a spring, to be used for eyeing the eggs, was alkaline in character. Therefore operations for collecting eggs were carried on, and as fast as taken they were shipped direct to Sisson to be eyed and hatched. This proved to be both successful and economical, as the station required then only the services of one man to watch the traps, collect the spawn fish, and place them in a "live-box." Notwithstanding the fact that the trap was twice washed out by high water, 417,000 eggs were collected the first season. This was not considered a fair test of the capacity of the stream, as the storms were unusually severe and a warm rain on the deep snowfall caused freshets.

Operations were continued in the spring of 1902, and a new trap was put in in February, but the first run was lost because of floods which washed out the trap and allowed the fish to pass on up the stream. In spite of these drawbacks, 686,000 eggs were taken by the last of May. The cost of collecting the eggs being so slight, it was considered that the efforts and money had been well expended and that it would be advisable to continue to operate the station. The station was operated for several years by the California Fish and Game Commission and was then turned over to the United States Bureau of Fisheries, which continued operations until 1919, when the station was again returned to this department.

A careful investigation of Cottonwood Creek with reference to the collecting of rainbow trout eggs was made during the spring and early summer of 1919, with the result that a lease for a new site was obtained from Mr. Marshall Horn and a permanent system of racks was installed therein to trap the spawning trout as they ascend the stream. A new and larger holding-tank for the fish was also installed, and with the new equipment it was possible to obtain 1,600,000 trout eggs in the spring of 1920.

SALMON EGG-COLLECTING EXPERIMENTS ON EEL RIVER.

The commercial fishing at the mouth of the Eel River and the spearing of the breeding salmon on the riffles on the upper reaches of the river necessitated the propagation of salmon in larger numbers on Eel River. Experimental work was carried on at an experimental station on Bull Creek, one of the tributaries of the South Fork of the Eel

River, and also in the main river near the mouth. The results of these experiments of the last three years have not justified the expense of establishing a permanent egg-collecting station on the lower reaches of the river.

There are several conditions in that region that make it seem impracticable to establish an egg-collecting station there. The salmon, upon entering the mouth of the river, are compelled to remain in the large pond below Loleta until the river rises in the fall, as there is not enough water during the seasons of normal rainfall to allow the fish to pass over the wide, shallow riffles connecting the large pools from South Fork to the large pool at the mouth of the river.

As a rule the river rises to a considerable extent, but not before the majority of the salmon are caught by the commercial fishermen at the mouth of the river in the large pool. It has been suggested that eggs be collected from the fish in the large pool during the early fall before they ascend the river or are taken by the commercial fishermen, but we find that the fish do not ripen in numbers great enough to justify the expense of seining them up and separating the few ripe ones from those that are green or immature. Furthermore, there is no water near the mouth of the river suitable for hatchery purposes. If eggs could be taken in sufficient quantities to justify the expense of collecting them, they would have to be taken direct to Fort Seward Hatchery on the railroad, some sixty miles up the river. The eggs collected would, in all probability, be in such small lots that it would not pay to keep the necessary help and equipment.

Any attempt to place racks across the main Eel River or the South Fork, anywhere near its mouth, is almost impossible, as the loose nature of the formation is not solid enough to hold the racks and, even if this were overcome, the tremendous amount of water that comes down Eel River during flood periods, carrying logs and debris of all kinds, would make it impossible to retain any kind of a rack in the river. Furthermore, if a rack could be built that would stand the flood water of the river when the salmon were running, the number of fish that would be entering the river would be all fresh run from the ocean and would have to be held too long in order to allow them to mature.

An egg-collecting station on Eel River or its tributaries must be situated far up the stream, away from the tremendous floods and the floatage matter in the river, and must be in the upper reaches near the spawning grounds, where the fish have spent the necessary time in fresh water for the breeders to mature.

It takes less fry to stock Eel River and maintain the run of salmon than any other river on the coast, as there are few natural enemies of the young of the salmon to be found in the river. There are no predatory fishes, no diverting canals to carry off the water where fry are lost, or overflow basins, and very few water snakes or other natural enemies. If only a few million eggs can be collected and the resulting fry planted each season, the run of salmon in Eel River can be easily maintained provided the fishing at the mouth of the river is regulated as well as the ocean fishing, where large numbers of salmon are taken each season.

EEL RIVER EGG-COLLECTING STATION.

Extensive egg-collecting equipment was installed during the fall of 1921 on the South Fork of Eel River, near Branscomb. Racks, traps, holding pens and cabins for the assistants have been put in on the South Fork of Eel River. Racks and traps have also been placed in Charlie Creek, and on Kinney Creek an eyeing station has been put in and racks, traps, pens, etc., installed. The station has been equipped for extensive operations, and it is the intention to collect the eggs of the steelhead trout as well as those of the salmon.

BROOKDALE HATCHERY.

In 1905 Mr. F. A. Shebley located a hatchery at Brookdale for the county of Santa Cruz, on a tributary of the San Lorenzo River, twelve miles from the city of Santa Cruz. It has proved to be one of the best steelhead hatcheries on the coast, and the increased number of steelhead trout in the streams of Santa Cruz County is sufficient evidence of the success of this station. An auxiliary of the Brookdale Hatchery was established on Scott Creek, and it has been jointly operated by the California Fish Commission and Santa Cruz County. The fry hatched from the eggs collected at this station are distributed in the waters of Santa Cruz, San Mateo, Santa Clara and Monterey counties, and some of the eggs are shipped to Sisson and Eel River hatcheries for distribution in other localities. Beginning with July 1, 1912, both Brookdale Hatchery and Scott Creek spawning station have been operated exclusively by the state and a general distribution made of the product.

EDGEWOOD EGG-COLLECTING STATION.

After the abandonment of the station at Verdi, the commission still considered it wise to establish a station on some stream where a supply of rainbow eggs could be collected at small cost. Superintendent W. H. Shebley of Sisson was sent to examine the different streams in Siskiyou County for that purpose. He selected a point on the Shasta River near Edgewood, Siskiyou County. The cost of operating was light and, besides, the eggs could be transported direct from the spawning station to the Sisson Hatchery, avoiding the expense of a double crew of men.

The station was operated for the first time in 1906, but owing to unusual freshets which swept over the racks, most of the spawning fish were able to pass them, so that only about 50,000 eggs were taken. This, however, was considered sufficient to demonstrate the value of the station. An agreement was entered into with the Federal Bureau of Fisheries, which desired to establish a rainbow egg-collecting station, whereby the federal bureau was to bear part of the expense of operation of the station and was to receive in exchange the privilege of eyeing their eggs in the Sisson Hatchery. This arrangement was considered mutually beneficial to both commissions, and it tended to insure a continuance of the harmonious relations that existed between the two.

THE SACRAMENTO EXPERIMENTAL STATION.

During the fall of 1911 the commission decided to carry on a series of experiments to determine whether the eggs of the quinnat salmon could be successfully hatched and the fry reared near the city of Sacra-

mento. It was thought that if water could be found in which the eggs could be hatched without causing injury to the eggs and embryos, a greater percentage of the fry would safely reach the ocean than would be the case if they were all liberated in the upper reaches of the river near the natural spawning grounds. It was maintained that under the old system of liberating the fry as soon as they were able to swim, a great many of them were devoured by predatory fishes, and others were carried into the overflow basins during years of flood.

Accordingly the station at Sacramento was established. Mr. F. A. Shebley conducted the work in addition to his duties as superintendent of the Brookdale Hatchery. The experiments as carried on at Sacramento were of vital importance to the salmon industry. After experimenting with the water from a number of wells, a flow of water was found on the Sherburn tract that appeared to be pure enough for salmon propagation. The fish hatched at this station were all released in the Sacramento River. Of these, 50,000 were marked in order to determine by careful observation whether a greater percentage return as mature salmon than those that were released on the upper reaches of the Sacramento River.

Nearly all of the fry that were liberated in the Sacramento River were floated in a screen cage by boat into the middle of the stream and there released. Mr. N. B. Scofield, however, took 500 in a floating box down the river, where they were held and fed for several weeks in brackish and salt water. They were not affected by the sudden change from the fresh to brackish and then to the saline waters of the straits near the outlet of the bay.

In the course of the experiments and in the search for suitable water for hatching purposes, two wells were bored and the water from other wells was also analyzed and experimented with. The batteries or series of troughs used in these experiments were set up in the open air near the wells, and the pumping plants were installed temporarily. The best results were obtained from the well on the Sherburn tract. Here a battery of 40 troughs was set up on the levee, and the pumping plant installed in a small building of corrugated iron. These experiments were continued until the season of 1912-1913, but with no favorable results. The water did not have the life-sustaining qualities of mountain stream water, although a well arranged system of aeration was used, and the conclusion was reached that the well water all through the valley contains too much mineral to hatch salmon eggs without destroying or injuring them so badly that they will not thrive if they should hatch out. The undertaking was accordingly abandoned in 1913, the station was closed and the troughs and other apparatus were shipped to the Sisson Hatchery.

BEAR LAKE HATCHERY.

With the aid of the San Bernardino Trout Association, San Bernardino County in 1914 built a trout hatchery with a capacity of 1,000,000 fish. The hatchery was located on the south side of Bear Lake. It was built under the supervision of Mr. E. W. Hunt, superintendent of the Tahoe Hatchery. The expense of the hatchery was borne by the members of the county association, and no money was solicited outside the

county. The board of county supervisors had charge of the distribution of the fish hatched and were able to see to it that the local streams were well stocked with the output.

The object of this hatchery was to propagate rainbow trout from the fish in Bear Valley Lake. Bear Valley Lake (locally known as Big Bear Lake) is a body of water seven miles long and one and a half miles wide at its widest part. It is an artificial storage lake lying in the heart of the San Bernardino Mountains, about thirty miles from San Bernardino, at an elevation of about 7000 feet. This lake was stocked previously with rainbow fry from the state hatcheries, and these fish thrived remarkably. The association did not make a success of the hatchery and turned it over to the Fish and Game Commission.

In 1919 the necessity of increasing the capacity of the Bear Lake hatchery at Green Spot Springs became apparent, the old buildings that had been erected by the Southern California Trout Association being found inadequate. After procuring a permit from the forest service for a site adjacent to the site leased from San Bernardino County, a new hatchery with modern troughs was erected and fully equipped for the hatching and rearing of trout fry. The site at Green Spot Springs is about twelve miles from the egg-collecting station at North Creek. This is the only water available for hatchery purposes near Bear Lake. All the creeks dry up as the summer advances, except some small springs used for domestic purposes.

The Green Spot Springs rise near the foot of Sugar Loaf Mountain and flow through a shallow ravine toward Baldwin Lake. The water is used by the Shay Brothers on their stock ranch, after it leaves the hatchery. There is approximately 20 inches of water in the spring. It is cool and free from any organic substances, and is excellent hatchery water.

During the summer and fall of 1919, general improvements at North Creek Egg-collecting Station were made, and a new hatchery at Green Spot Springs with a capacity of 1,500,000 fry was erected. The work was begun early in September, but owing to delays in getting materials was not finished until late in November. At the hatchery at North Creek Egg-collecting Station, a portion of the eggs are hatched each season and the fry held until they are swimming well; then they are distributed in the most favorable places in Bear Lake, where there is an abundance of natural food. The fry can not be held in North Creek station later than the middle of July, as the water in North Creek fails by that time. The remainder of the fry reared for Bear Lake are held in the hatchery at Green Spot Springs until later in the season, when they are distributed in the lake in the shallows and other favorable spots.

During 1919 plans were made to build suitable quarters for the help at North Creek Egg-collecting Station, a cabin and a new trap on Metcalf Creek, and a cabin and a trap on Grout Creek. A new trap was built in North Creek, and the egg-collecting station and hatchery were repaired and improved.

The principal streams entering Bear Lake—North Creek, Metcalf Creek, Butler Creek and Grout Creek—were filled with sand from the high-water mark on the lake shore to the water's edge, averaging in

length from one-fourth to one-half mile. The creeks are all short, but carry a large amount of granitic sand caused by the disintegrated granite formation through which these streams flow. These creeks had been filling up for several years, until in the spring of 1919 it was almost impossible for the breeding trout to enter them, as the water was spread over such a wide area of sand deposits that the fish could not find water of sufficient depth for them to swim in. In order to open these channels so that the fish could enter the streams and reach the traps, teams and scrapers were hired and the channels excavated through the sand deposits so that the water would have sufficient depth at the mouth of the creeks. The spawning area above the traps is so small that it does not justify allowing any of the fish to spawn naturally. The streams nearly all dry up before the eggs are hatched, even if they are allowed to ascend the streams and deposit their eggs. The majority of the eggs deposited by the breeders below the traps do not hatch, as they are covered over with the sand that packs so tight over the eggs that they are smothered. Consequently the stock of fish in Bear Lake must be kept up by artificial propagation almost entirely.

Years ago, when the lake was first stocked, the sand deposits were not so great, as the flood waters scoured the streams out each season; but during the last five or six years the sand has accumulated to such an extent that the creeks must be kept open by removing the sand every two or three years so that the fish can reach the traps.

Bear Lake has an abundance of natural feed for the trout. Besides the minnows there are a great many varieties of aquatic insects that abound in the lake in great numbers. During the last three seasons of drought these insects have increased, so that it is safe to say that there is not another body of water of equal size anywhere that has the same amount of natural food for trout.

SNOW MOUNTAIN EGG-COLLECTING STATION.

The Snow Mountain Egg-collecting Station was established in 1907. Early in the season of 1915 the commission secured a lease on the Cape Horn dam from the Snow Mountain Water and Power Company for one year, with the option of an additional five years. This lease gave the commission the use of the grounds and buildings, as well as the privilege of constructing tanks, traps, etc., on the land described in the Snow Mountain Egg-collecting Station lease. The dam that makes it possible to collect the fish is located on the south fork of Eel River, about twenty-five miles from Ukiah, Mendocino County. All the steelhead trout that ascend this branch of Eel River are easily trapped in the fishway over the dam. A small battery of hatching troughs was installed and holding pens for the spawning fish were provided. As the fish ascend the fish ladder they are automatically trapped and swim directly into the holding pens, from which they can not escape. It is a very cleverly arranged scheme, and in addition to being a saving by eliminating a great deal of work, lessens the loss of fish from handling. Snow Mountain station is one of the best steelhead egg-collecting stations on the coast.

FORT SEWARD HATCHERY.

Owing to the undesirable location of the Price Creek Hatchery, it was decided to remove it to a more favorable site. Price Creek Hatchery was located on Price Creek, one-half mile from its junction with Eel River. The creek has its source in the hills near the mouth of Eel River. The country through which it flows is a loose, friable and disorganized formation that is constantly sliding and washing away. During the winter months the creek was so full of sediment that it was only with the greatest skill and care that fish could be reared at all. In the spring the water dried up rapidly and became very warm, so that it was impossible to hold the fry later than June. The commission decided, therefore, to remove the hatchery to a more favorable location. The Department of Pisciculture was instructed to select a suitable site and to move the station. After a careful survey of the streams on the line of the Northwestern Pacific Railroad, Fort Seward Creek was selected, a cold, clear stream, flowing into Eel River and about four and one-half miles above old Fort Seward, Humboldt County. The commission purchased forty acres of land near the mouth of the creek and selected a site for the hatchery about one-quarter of a mile from the Northwestern Pacific Railroad.

Early in 1916 the work of moving the building and equipment to the new site on Fort Seward Creek was begun, being completed and ready for the spring hatch of eggs. A cottage for the superintendent and a cabin for the men were erected and finished in a rough way until more comfortable quarters could be arranged.

The hatchery building is situated near the creek in a narrow canyon and the superintendent's dwelling on an eminence overlooking the hatchery. As funds were limited at the time the hatchery was established, only a poorly constructed cabin could be built for the help besides the cottage for the superintendent. During the fall of 1919, two four-room cottages, of plain interior finish and shingled outside, were built, so that men with families could be employed.

The water in Fort Seward Creek is the only water suitable for hatchery purposes on the line of the Northwestern Pacific Railroad. There are several streams between South Fork station and Fortuna, but they all have their sources in the same sedimentary formation as Price Creek, where it was necessary to abandon the hatchery owing to the great amount of sediment carried in the water during the winter and spring, when the rainy season was at its height.

The fry produced at this hatchery are the best reared in any of the hatcheries located in the coast counties.

YUBA CITY SHAD HATCHERY.

Early in the season of 1916 the question of propagating shad was taken up by the Department of Pisciculture. The heavy fishing for shad in the bays and in the Sacramento and San Joaquin rivers in previous years had caused noticeable falling off in the numbers of these fish, and to keep the supply up it was deemed necessary to resort to artificial propagation.

About the same time, a request was received from the Massachusetts and Connecticut fish and game commissions requesting the California

commission to collect shad eggs from California waters and ship them to their hatcheries, as they were desirous of restocking the depleted waters of the Eastern states with shad. Shad were introduced into California from New England states by the California Fish Commission in 1871. They increased rapidly until a few years ago, and the Sacramento and San Joaquin rivers were fairly alive with them in the spring and summer, when the run of shad was at its height.

The excessive fishing and pollution of the Eastern rivers has caused the shad to become very scarce, and it was the desire of the Massachusetts and Connecticut commissions to restock their waters. It was decided to collect the shad eggs for the two commissions, as it was considered an opportune time to carry on experiments to locate the spawning places of shad, as well as to make experiments to determine whether shad culture could be carried on successfully in California and to determine whether the process of fertilizing the eggs and propagating the fry could be improved upon.

Consequently the commission decided to operate a shad hatchery on a small scale during 1916, to carry out the experiments and to gather data in preparation for more extensive operations the following season. When operations were begun, in May, it was thought that all the eggs necessary for the shipments East, as well as for our experiments, could be collected by the latter part of May or early in June, but the season proved to be unfavorable and the work dragged along into July without sufficient eggs being obtained at one time to make a shipment East.

Fishing began on June 3 at Yuba City. The run was poor all through the season in the upper reaches of the rivers; nowhere near its size in former years. The light run of shad in the upper river was due to the very cold spring, cold water, and later to the high, roily water caused by the melting snow in the higher altitudes. During the season 1,421,000 shad eggs were collected and 872,000 fry hatched and successfully released in the Feather River. This work was under the immediate supervision of Superintendent G. H. Lambson of the Mount Shasta Hatchery.

BURNEY CREEK EGG-COLLECTING STATION.

In the spring of 1915 a lease was secured on a piece of land at the mouth of Burney Creek, a tributary of Pit River, Shasta County, for the purpose of collecting rainbow trout eggs. A rack was placed across the stream and the necessary live cars and pens were made to hold the fish that were expected to enter the creek. A tent and a few troughs under it with hatching equipment was set up and operations were begun. It was originally planned to eye the eggs and hatch them in the old Hat Creek Hatchery, seven miles from Burney Creek, if a sufficient number were taken; but early in May an eruption of Mount Lassen sent a tremendous flood of mud, water and sand down the Hat Creek Valley, destroying all the fish in the stream from its source to its confluence with the Pit River. This was one of the most serious destructions of fish life in recent years in California. Hat Creek rises in the southeastern part of Shasta County, in a lake at the foot of Mount Lassen, at an altitude of 7300 feet above sea level. It flows northerly into the Pit River, two miles northwest of Carbon, where

the old Hat Creek Hatchery was located. It is thirty-eight miles in length. Its principal tributaries are Rising River, a short stream arising from large springs in the lava, and Lost Creek. Rising River is only two miles in length, but has an average flow of 380 second-feet of water. Hat Creek, before its confluence with Rising River at the town of Cassell, has an average flow of about 100 second-feet during the summer months. Hat Creek and its tributary, Rising River, were noted for the excellence of their rainbow trout. After the flood of mud and Sand from Mount Lassen, the only survivors in the valley were those that were in Rising River. The water was muddy all during the season of 1915, and during the following years continued so muddy that it was not considered practical to restock the stream. It will probably be several years before fish will again thrive in Hat Creek, as the shifting sand deposited by the volcano destroys all the insect life in the stream, as well as making it uninhabitable for trout.

The fish enter Burney Creek late in the summer, but the run is a protracted one, lasting from April to August. The fish are late in developing, and if the fry were reared in a higher altitude and the progeny spawned later each season, a fall-spawning rainbow trout could probably be developed. This might have some advantages over a spring-spawning fish, as such trout would be in fine condition for the anglers when the fishing season opens in the spring.

MARLETT-CARSON HATCHERY.

The supply of eastern brook trout fry was increased considerably in 1916 and 1917. The Nevada State Fish Commisison did not operate its hatcheries, and the California commission was able to secure the privilege of collecting eggs from Marlett Lake, Nevada. The Carson City Hatchery was taken over by the commission, and the eastern brook trout eggs collected from Marlett Lake were shipped to this hatchery, where they were eyed and prepared for shipment. At this station 690,000 eggs were collected. The second year but half the eggs taken were to go to California under the agreement entered into. The share shipped to the Mount Shasta Hatchery amounted to 200,000 eggs.

DOMINGO SPRINGS HATCHERY.

An experimental hatchery was established at Domingo Springs in 1916. Improvements were made during 1917, when the temporary plant was moved to Rice Creek, one of the main branches of the North Fork of the Feather River above Lake Almanor. A thorough test of the water and an investigation of the run of fish resulted in the establishment of a permanent egg-collecting station and hatchery at this place. Accordingly, during the summer and fall of 1919, a permanent building was erected and a substantial trap constructed, one-quarter of a mile below the falls, in Rice Creek. The site was procured from the United States Forest Service. This desirable station will furnish fry for the entire region surrounding the west side of Lake Almanor, as well as the lakes and streams in the Mount Lassen National Park and surrounding country.

ALMANOR HATCHERY.

Almanor Hatchery was established in 1916 at the Big Meadows dam of the Great Western Power Company on Lake Almanor. It produced 261,000 rainbow eggs in 1918 and 282,000 in 1919. The water supply fails too early in the summer to permit the hatching and rearing of fry at the station, and accordingly the eggs were transferred to Clear Creek or Domingo Springs hatcheries as soon as they were "eyed."

YOSEMITE EXPERIMENTAL STATION.

With the intention of keeping the streams of the Yosemite Valley adequately stocked with trout fry, the commission during the fall of 1917 made a survey of conditions obtaining in the valley with reference to the establishment of a hatchery. A suitable site was obtained for a fine hatchery near Happy Isles, and application was made to the Department of the Interior for a lease to the property required for operations. Every assurance was given by the Yosemite Park officials that the department would grant a suitable lease, and pending the outcome of negotiations for the same the commission took advantage of a temporary permit granted it to establish an experimental hatchery on the site, in order that it might be definitely determined as to the practicability of the location for the propagation of trout. Arrangements were made with the State Department of Engineering for the preparation of suitable plans for the permanent hatchery.

The experimental station was established during the fall and winter of 1918 and was opened up for operations in the spring of 1919. Four hundred thousand rainbow, black-spotted and steelhead trout eggs were shipped to the station, and the resulting fry were reared and planted in the streams and lakes of the Yosemite Valley with the cooperation of park officials. The fry produced were vigorous and healthy and attained an unusual size in the few months that they were reared in the hatchery.

The site was demonstrated as being satisfactory for hatchery purposes, but as it is against the policy of the state to erect permanent buildings on leased land it was decided at a meeting of the Board of Fish and Game Commissioners, held during the latter part of October, 1920, to abandon the project. All equipment was therefore removed from the site and transported by auto trucks to the Wawona Hatchery, where it has been used to equip that station for more extensive operations.

MOUNT WHITNEY HATCHERY.

On February 2, 1917, the Mount Whitney Hatchery, located on a forty-acre tract on Oak Creek near the town of Independence, Inyo County, was turned over to the Fish and Game Commission by the Department of Engineering, under whose supervision the hatchery was constructed. The building is a beautiful structure of granite and gabbro, and the coloring of the rubble walls blends harmoniously into the background of giant peaks that form the west wall of the valley. The building contains offices, storerooms and a laboratory on the lower floor and living quarters for the help in the upper story of the structure. It is equipped with up-to-date plumbing. All the troughs have

a separate water supply. The aerating system is on the latest and most modern lines. The waste pipes, catch basins and drains are all of concrete. As a matter of necessity the first season's output was comparatively small, but the 1,285,000 fish distributed in the waters of southern California, the lower San Joaquin Valley, Inyo and Mono counties, were an exceptionally fine lot of fish. The ample supply of pure water in Oak Creek, that gushes from the granite rocks of the basal slopes of the Whitney Range, has proved to be excellent for the propagation of trout. The fry advance very rapidly and are strong



FIG. 38. Picturesquely situated at the eastern base of the Sierra in Inyo County, the Mount Whitney Hatchery is the best constructed and best equipped hatchery in the state.

and vigorous. The distribution of the fish has been very satisfactory in every particular.

The grounds around the hatchery have been ornamented and improved. A large pond has been constructed, in which there are a number of adult trout of different species. Surrounding the pond are extensive lawns and beautiful flower gardens, roadways, paths, etc. While it is true that the station is located at a considerable distance from some of the southern California and San Joaquin Valley sections, which receive their supply of trout therefrom, the transportation facilities are very good, the trains being run on schedules which permit of the fish being delivered to the applicants within a very short time after leaving the hatchery. Consequently the fry are in the very best possible condition when planted in the streams. While it may appear, to one not familiar with the existing conditions, that the distribution of the fish from Mount Whitney Hatchery is more expensive than from

other stations on account of the high rate of fares from Mojave to Owenyo, the very reverse is true, for the trips of the distribution car are all comparatively short ones, enabling distribution work to be completed within a short time, which materially lessens the cost of distribution. But the most important feature of this hatchery is the excellence of the fry produced. They are truly wonderful fish, and the advantage to the southern waters resulting from the planting of such fry is inestimable.

The most interesting work undertaken at this station, from a fishcultural standpoint, has been the propagation of golden trout obtained from the Cottonwood Lakes station. The propagation of this species is very difficult, owing to the weakness of the embryos. The embryos hatched seem to lack vitality, and it is only by exercising the greatest care and patience in handling the eggs during incubation and in caring for the embryos, that the fry survive at all. However, golden trout are being successfully reared, and some very excellent results are expected from the stocking of the streams and lakes of the southern high Sierra, in which section conditions are propitious for the successful development of this species.

A supply of rainbow trout eggs is procured from the Rae Lakes, a system of lakes lying in the heart of the Sierra at an elevation of 10,500 feet above sea level.

RAE LAKES EGG-COLLECTING STATION.

The Rae Lakes Egg-collecting Station was established during the late spring of 1917 to furnish rainbow eggs for the Mount Whitney Hatchery. At the site of operations the altitude is 10,500 feet above sea level, located on a beautiful chain of lakes set in the heart of the high southern Sierra in Fresno County. The lakes are well stocked with rainbow trout. To reach the station in time to trap the fish as they enter the streams to spawn is extremely difficult. The trip into the lakes must be made via Oak Creek Pass, at an elevation of over 11,000 feet. There are few trails and the trip must be made through the blind mountain passes, over great depths of snow. Severe snow storms in this section, even in June, when the fish are spawning, are frequent. Even when the days are clear and warm the nights are freezing cold, and the journey through the passes is at best a difficult one, taxing the strength and resourcefulness of the hardiest mountaineers. Owing to the difficulties attending the opening up and operation of this station, and to the fact that sufficient skilled help to operate all the state hatcheries to capacity could not be obtained, this station was not utilized during 1918 and 1919. It was again operated in 1920 and 1921.

COTTONWOOD LAKES EGG-COLLECTING STATION.

During the summer of 1917, preliminary surveys were made of the Cottonwood Lakes country, Inyo County, to ascertain whether it would be feasible to undertake the propagation of golden trout.

The Cottonwood Lakes are situated in a rugged, almost inaccessible section of Inyo County near the Tulare County line, at the head of Cottonwood Creek. The lakes were stocked in the early seventies with golden trout from Mulkey Creek, a tributary of south fork of Kern River, and are now teeming with this most beautiful and gamey fish.

It was found that a number of creeks flowing into the lakes furnish excellent spawning grounds, and on what appeared to be the most favorable locations it was decided to put in racks and trap the fish as they ascended the streams to spawn. All arrangements were made to be on the ground at the proper time. All of the lumber, tools, tents, camp equipment and supplies had to be transported by pack train overland from Lone Pine. However, this was all successfully accomplished, and the men reached the site of the station in ample time to catch the first of the fish ascending the streams to spawn. Five hundred thousand eggs were taken and were successfully transported by pack animals from the spawning station to Mount Whitney Hatchery. The resulting fry were distributed in waters of that section.

The remoteness of the site of operations from railroads, highways or, indeed, any human habitations, the high altitude and prevalence of snow storms, make the trip into this remote section at this season of the year actually dangerous at times. Nevertheless the work has been continued, and crews have gone into the "lakes" each season and successfully accomplished their mission. The results obtained have justified all the hard work and expense. Although several efforts have been made in past years to collect the eggs of the golden trout, the attempt during 1918 was the first successful one. The success of the operations has been due to the skill and resourcefulness of Mr. George McCloud, who was in personal charge of the golden trout egg-collecting operations at Cottonwood Lakes and of Mount Whitney Hatchery, at which station the eggs were hatched and the fry reared. The golden trout are very difficult to rear, but the results obtained in this delicate work have exceeded expectations. The station was again operated in 1919 and 1920, but due to adverse weather conditions was not opened in 1921.

FEATHER RIVER EXPERIMENTAL HATCHERY.

During the spring of 1918, following out the plan of increasing the number of small hatcheries throughout the state, an experimental station was established in Plumas County, on the line of the Western Pacific Railway on a site on Grey Eagle Creek, about a mile from the town of Blairsden. Steelhead eggs were shipped to the station from Snow Mountain station, black-spotted eggs from Tallac Hatchery, and rainbow eggs from Domingo Springs station, the plan being to thoroughly try out this site in order that a permanent hatchery might be erected thereon should the water prove to be satisfactory for hatchery purposes. From this hatchery all of the trout fry for Plumas, Lassen and Modoc counties, along the line of the Western Pacific and the Nevada, California and Oregon railways could be hatched and distributed. With the inland territory in the Westwood, Lake Almanor and Juniper Lake districts covered by the Clear Creek and Domingo Springs hatcheries, and all railroad deliveries for the three counties above mentioned taken care of by the Feather River Hatchery (as the plant near Blairsden was to be named), all long hauls to this section from the Mount Shasta Hatchery could be eliminated. Unfortunately the water of Grey Eagle Creek did not prove satisfactory for hatchery purposes, and it became necessary to locate the hatchery in this section on some other creek. In 1921 the hatchery was moved to a site on Jamison

Creek, a tributary of Feather River. The station is located near Johnsville, in Plumas County. The operations last season were successful, and accordingly plans were made for the establishment of a permanent hatchery at this site.

CLEAR CREEK HATCHERY.

The Clear Creek Hatchery and Egg-collecting Station was established in the fall of 1918, on the creek that bears its name, one and one-half miles from the town of Westwood, Lassen County. Clear Creek is a tributary of the Hamilton branch of the Feather River, and a large portion of the spawning rainbow trout that ascend the Hamilton Branch of the Feather River enter this stream. As the source of Clear Creek is in a large spring, the water is pure and cold. The Red River Lumber Company furnished the site and material for the Clear Creek Hatchery, and the Fish and Game Commission furnished the labor for construction. Operations at this hatchery have been very satisfactory.

FALL CREEK HATCHERY.

In January, 1913, the California-Oregon Power Company began the construction of a concrete dam in the Klamath River two and a half miles above the mouth of Fall Creek in Siskiyou County. This dam, 110 feet high, has required a great deal of study on the part of the fishcultural department. The great problem involved was whether an efficient fishway could be constructed on such a dam, and if such a fishway were constructed, what would be the benefit derived from such an undertaking. The principal run of fish on the Klamath River in the region of the Copco dam is trout and salmon. The Federal Bureau of Fisheries has operated a salmon egg-collecting station on the river below the dam and have for the last eight years prevented the salmon from ascending the river above the racks at Hornbrook. This is necessary in order that the supply of salmon may be maintained in the Klamath River. If the racks were removed and the salmon allowed to ascend the river, and a fishway constructed that would allow the passage of the breeding salmon above the dam, the resulting fry would have to return to the ocean and on their downward journey would be destroyed by the power wheels of the hydroelectric plant that takes the water from the dam. Therefore the construction of a fishway for the passage of salmon above the Copco dam was not feasible. Accordingly, in compliance with the law, the Fall Creek Hatchery was constructed and paid for by the California-Oregon Power Company in lieu of constructing a fish ladder over the Copco dam in the Klamath River.

Under the provisions of the law passed by the legislature, whenever a dam or other obstruction is placed in a river or stream that, in the judgment of the Fish and Game Commission, is too high for the successful operation of a fishway, or for other reasons it is deemed best to establish a hatchery below the dam for the propagation of any species of fish that may be interfered with by the construction of the dam, the owners of the dam must construct and equip a hatchery for the purpose of propagating fish for the river and turn the hatchery over to the state for operation.

A site was selected on Fall Creek, a tributary of the Klamath River, at a distance of fourteen miles from the town of Hornbrook and along the line of the old Klamath River Railroad. A substantially constructed hatchery building, with a capacity of 100 hatching troughs, a cottage for the foreman and living quarters for assistants, comprise the equipment. The hatchery, completely equipped for fishcultural operations and with a capacity sufficient to adequately take care of requirements in that section, was completed and ready for operation in the spring of 1919. The Chinook salmon eggs, taken at the Klamathon Hatchery during the previous fall, were hatched here and the fry reared for distribution in the Klamath River and tributaries during the spring and summer of 1919.

A large portion of the rainbow trout eggs taken at the Bogus Creek station are immediately transferred to the Fall Creek Hatchery, where they are "eyed," and later all surplus eggs over and above the amount required for stocking the Klamath River are shipped to other stations to be hatched and reared for general distribution. The racks and traps are located at Klamathon, where successful egg-collecting operations have been carried on by the California Fish and Game Commission and the United States Bureau of Fisheries for several years. The hatchery on Fall Creek is but twelve miles from the racks at Klamathon.

BOGUS AND CAMP CREEK EGG-COLLECTING STATIONS.

Since 1910, rainbow trout egg-collecting operations have been carried on in the Klamath River section by trapping the spawning fish as they ascend Bogus Creek and Camp Creek. The racks, traps and holding tanks in both of these creeks were in a very poor state of repair by 1919, and accordingly, in the fall of that year, the old egg-collecting plant was removed and new equipment installed. The success of operations after the new equipment was installed was very marked.

The spawning operations at these two creeks are carried on by the same crew, as they are but a short distance apart, Bogus Creek being on one side of the Klamath River and Camp Creek a short distance above on the opposite side of the stream. Accordingly the two camps are operated under the name of Bogus Creek station.

KLAMATHON HATCHERY.

In order that the run of Chinook salmon in the Klamath River might be properly maintained, it was deemed essential that the department increase the extent of its operations with reference to this locality.

For many years past the Klamath River has been stocked each season with Chinook or king salmon fry, the supply being principally obtained from eggs taken from the Sacramento River. The United States Bureau of Fisheries had operated the egg-collecting station at Klamathon, and the eggs here taken were mostly shipped to Sisson, where they were hatched, reared, shipped back and planted in the Klamath River. The bureau also hatched some fry at Klamathon, and these fry were planted early in the spring. However, the station was not well equipped for general operations, the water supply was poor and uncertain, and consequently the extent of the operations was limited and the results obtained were far from adequate. After a careful

deliberation it was decided that some radical changes in the method of stocking the Klamath River must be undertaken. The matter was taken up with the Bureau of Fisheries and it very kindly agreed to turn the station over to the commission, donating also the use of most of the equipment, buildings, etc.

Construction of the racks, as a part of the Fall Creek Hatchery system, by the California-Oregon Power Company, was begun during the fall of 1918 and was finished in time to secure a small number of salmon eggs. Under the commission's plan of operation it was decided to take the eggs at Klamathon station and ship them to the new Fall Creek Hatchery, which was under construction at the same time, where they would be hatched, reared and planted in the Klamath River and tributaries. Nearly a million Chinook salmon eggs were secured during the fall of 1918, the first year of operation. During the fall of 1919 this station was prepared to operate at full capacity. Nearly 5,000,000 eggs were taken, despite the extreme drought, which materially affected the run of salmon in the Klamath River. The take of eggs has increased each year until, during the fall of 1921, a total of 19,000,000 eggs were procured. These eggs were all eyed at Mount Shasta and Fall Creek hatcheries, and the resulting fry were given the usual distribution.

KAWEAH HATCHERY.

Early in the spring of 1919 it was decided that to adequately stock the streams of Fresno, Tulare and a portion of Kern counties, a hatchery should be located in the most favorable situation in that district. Accordingly the proper investigations were made and a site located on the Kaweah River, near the town of Hammond, in Tulare County, chosen as the most favorable for the purpose.

The site is located on the property of the Mount Whitney Light and Power Company, on the main highway to the General Grant and Sequoia national parks, and has a water supply which is most excellent for hatchery purposes. It is the central distributing point for stocking the streams in that entire section. The location being all that could be asked for, an experimental station was established to determine the suitability of the water supply for fishcultural purposes. Three hundred thousand rainbow, 50,000 black-spotted and 100,000 steelhead trout eggs were hatched at the station during the spring. The resulting fry were reared to an advanced stage and were given a wide distribution in the streams of the Sequoia and General Grant national parks and the entire Kaweah River system during the months of August and September. The fry were strong and vigorous and at the time they were planted had attained an unusual size. It was demonstrated by the season's operations that the site selected was entirely satisfactory for the establishment of a permanent hatchery. The temporary hatchery has been operated each season, and will be until funds are available for putting up a permanent building.

SAN JOAQUIN EXPERIMENTAL SALMON HATCHERY.

The Kerckhoff dam, property of the San Joaquin Light and Power Company, that has recently been completed near Auberry's on the San

Joaquin, prevents the passage of the salmon to their former breeding grounds on the upper reaches of the river.

The Merced River will no longer afford a spawning ground for salmon, as a large irrigation project is planned that will hold back the flood waters of the Merced in a lake to be made by the construction of a high dam across the river near Exchequer. Plans had been made for the construction of fishways over the small dams in the Merced River, property of the San Joaquin Light and Power Company, and arrangements made for their construction, but the plan of the large irrigation reservoir makes it impracticable to attempt any further efforts to perpetuate the run of salmon in the Merced River. With the completion of the Kerckhoff dam and the proposed dam at Exchequer, the spawning grounds for salmon on the San Joaquin River and its tributaries are practically all cut off from the breeding salmon. During seasons of normal rainfall a few salmon will probably spawn near Friants, below power house No. 4 of the San Joaquin Light and Power Company. This area is very small and would not have any effect in keeping up the run of salmon in the river.

An experimental salmon-culture station was established on the San Joaquin River in 1921, with the object in view of determining what the expense would be of collecting the eggs near Friants in the fall and transporting them to the hatchery on Willow Creek, a distance of about thirty-five miles, hatching the eggs and rearing the fry in ponds, the fry to be held in the ponds until the following fall, then conveying them by auto truck to the river, below the Kerckhoff dam.

This plan proved impractical, owing to the inaccessible location of the site during the winter months and the great distance over rough roads which the green eggs would have to be carried in the fall. Plans are being made for the construction of a salmon-egg collecting station and hatchery on the San Joaquin River near Friants. This station will have to be constructed by the San Joaquin Light and Power Company, whose operations on the San Joaquin River have broken up the salmon run by the construction of high dams and the diversion of the water through a tunnel 17,000 feet long, through which the entire flow of the river passes during the summer months, leaving the bed of the San Joaquin River dry for a distance of twelve miles during the late summer and fall.

CONCLUSION.

This history should demonstrate that from small beginnings fishcultural operations have grown until California is a leader among the states in its output of trout and salmon. At the present time the state owns and operates thirty hatcheries and egg-collecting stations. Of this number, seven have been built within the last seven years. Each of the hatcheries is fully equipped and the largest one has a capacity of about 40,000,000 trout and salmon per year. Two railroad cars specially fitted for the transportation of the eggs and fry are maintained and operated to distribute the output. At several of the hatcheries auto trucks are utilized for short hauls to and from the railroad station, and in some cases for planting. In the maintenance of these hatcheries and egg-collecting stations, it is necessary to employ during the summer season nearly sixty men.

Had it not been for the stocking of barren streams, almost all of the rivers and creeks now furnishing good trout fishing would be devoid of fish. Name any of the prominent summer resorts, such as Big Bear Lake in southern California, Huntington Lake, Yosemite, The Pines, and you will find that previous to planting operations no trout fishing was to be had in the locality. The Bear Lakes, in San Bernardino County, as a result of planting now afford recreation and are a food supply to no less than 50,000 people annually, and improvements about the lake represent an investment of not less than \$1,000,000.

Nine out of every ten persons summering at Bear Lake are interested mainly in the splendid trout fishing. The lakes and streams of Siskiyou and Shasta counties, of the Feather River region, of the Tahoe region, of the Yosemite region and of the upper regions of the San Joaquin, Kings and Kern rivers, teem with trout simply because the streams have been stocked. Several years ago the dams and lumber mills along the Truckee River destroyed the run of black-spotted trout in that stream. Had it not been for the introduction of other fish into this stream, anglers would now find few fish. However, eastern brook, Loch Leven and rainbow trout are now found in abundance in this stream—not native fish, but introduced species.

Not only have barren streams been stocked so that a new source of sport and food is available, but the supply has been maintained by constant planting. Depletion is to be noted wherever anglers are abundant, and were it not for restocking, the supply in many places would have failed long ere this.

Although the maintenance of California's hatcheries is costly, yet the output more than justifies the expense. The accompanying figures give some idea of the annual output and the consequent benefit to the people of this state:

Compared with the figures given for the output of Eastern hatcheries, it will be noticed that the number of fish reared is less. But it should be borne in mind that Eastern states deal largely with inferior fishes, producing large numbers of very small-sized eggs, whereas California rears trout and salmon which have large eggs. The general public does not sufficiently appreciate the accomplishments in this line of work. Even the applicants are so accustomed to having their requests for thousands and tens of thousands of trout fry met annually, and substantially as requested, that they little realize all the work and planning it takes to produce the fish, or the sum of money necessary to rear the millions of fish demanded.

Sections of the state in the most remote recesses of the high Sierra, which but a few years ago could be reached only by pack trains with the assistance of hardy mountain guides and days and often weeks of travel, are now reached in but a few hours from the main centers of population by automobiles, over some of the finest highways in the world. There can be but one result from such a condition of affairs, and that is the practical destruction of fishing in the majority of the waters of the state, unless the most stupendous efforts are put forth, and at once, to conserve our game fishery resources and to increase the

1871 TO 1921 INCLUSIVE

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extent of the operations of the fishcultural department. Every effort has been made to keep pace with the demands of the situation, but there is a limit set by the proportion of the financial income of the commission which can be devoted to fishculture.

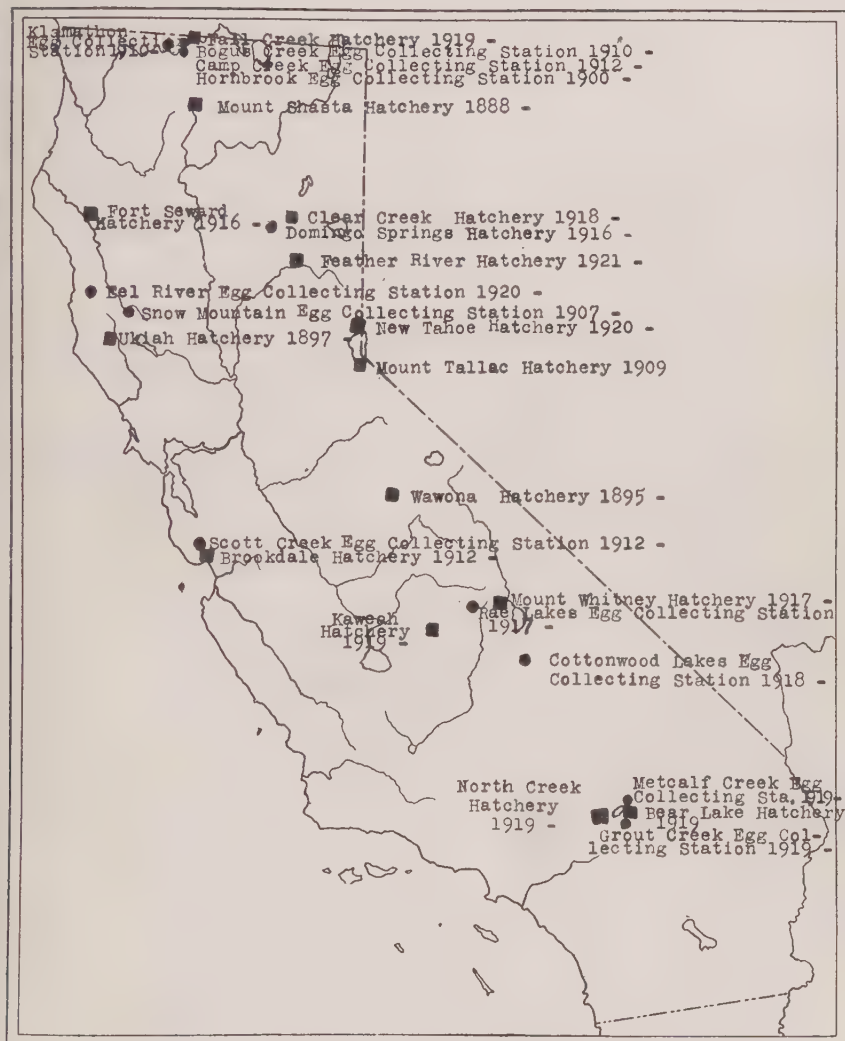


FIG. 39. Map showing location of present hatcheries and egg-collecting stations and year established.

HATCHERIES AND EGG-COLLECTING STATIONS, 1870-1921.

Name	Location	Years of operation
Acclimatization Society Hatchery.....	City Hall, San Francisco.....	1870-1871
State Hatching House.....	University of California, Berkeley.....	1870-1877
Baird Fish Hatchery (U. S. Bureau of Fisheries)	McCloud River, Shasta County.....	1872-
	(Rebuilt)	1881-1883
		1888-1920
Clear Creek Experimental Hatchery.....	Clear Creek, Lake County.....	1873-1874
Frazier Hatchery.....	Squaw Creek, Nevada County.....	1875-1880
San Leandro Hatchery.....	San Leandro, Alameda County.....	1878-1883
Hurley Hatchery.....	Tahoe City, Placer County.....	1880-1888
Woodson Egg Collecting Station.....	Fort Bidwell.....	1881-1884
Shebley Hatchery.....	Shebley's Station, Nevada County.....	1883-1888
Phipps Hatchery.....	Lake Tahoe, El Dorado County.....	1884-1888
Hat Creek Hatchery.....	Carbon, Shasta County.....	1885-1888
Mount Shasta Hatchery.....	Sisson, Siskiyou County.....	1888-
Tahoe Hatchery.....	Tahoe City, Placer County.....	1889-1891
		1894-1920
Fort Gaston Fish Hatchery (U. S. Bureau of Fisheries).....	Trinity River, Hoopa Indian Reservation, Humboldt County.....	1889-1898
Shovel Creek Egg Collecting Station.....	Klamath River, near Beswick, Siskiyou County	1889-1912
Glen Ellen Fish Hatchery (private hatchery controlled by state).....	Glen Ellen, Sonoma County.....	1890-1891
Del Monte Fish Hatchery (private hatchery controlled by state).....	Del Monte, Monterey County.....	1890-1891
Bear Valley Hatchery.....	Olema, Marin County.....	1891-1894
Alma Fish Hatchery (private hatchery controlled by state).....	Alma, Santa Clara County.....	1892-1893
Korbel Fish Hatchery (U. S. Bureau of Fisheries)	Redwood Creek, Mad River, Humboldt Co.	1893-1897
Independence Lake Fish Hatchery and Egg Collecting Station.....	Independence Lake, Nevada County.....	1893-1894
Redwood Creek Egg Collecting Station (U. S. Bureau of Fisheries).....	Redwood Creek, Humboldt County.....	1893-1897
Battle Creek Fish Hatchery.....	Battle Creek, Shasta County.....	1895-
Wawona Hatchery.....	Wawona, Mariposa County.....	1895-
Mount Tallac Hatchery.....	Taylor Creek, El Dorado County.....	1895-1909
Price Creek Hatchery.....	Price Creek, Grizzly Bluff, Humboldt Co.	1897-1916
Ukiah Hatchery.....	Ukiah, Mendocino County.....	1897-
Mears Creek Egg Collecting Station.....	Near Sims, Shasta County.....	1898-1899
Hazel Creek Egg Collecting Station.....	Near Sims, Shasta County.....	1898-1899
Hornbrook Egg Collecting Station.....	Cottonwood Creek, Siskiyou County.....	1900-
Campbell Creek.....	McCloud River, Shasta County.....	1901
Squaw Creek.....	McCloud River, Shasta County.....	1901
Howe Creek Egg Collecting Station.....	Eel River, Humboldt County.....	1902
Mill Creek Hatchery (U. S. Bureau of Fisheries operated by state).....	Los Molinos, Tehama County.....	1902-
California State Verdi Fish Hatchery.....	Verdi, Nevada State.....	1902-1905
Edgewood Experimental Station.....	Upper Shasta River, Siskiyou County.....	1906-1907
Snow Mountain Egg Collecting Station.....	Eel River, Mendocino County.....	1907-
Shasta River Egg Collecting Station.....	Yreka, Siskiyou County.....	1907-1908
Bouldin Island Bass Hatchery (striped bass).....	Bouldin Island, San Joaquin County.....	1907-1909
Glen Alpine Hatchery.....	Glen Alpine Springs, El Dorado County.....	1908-1913
Bogus Creek Egg Collecting Station.....	Klamath River, near Hornbrook, Siskiyou County	1910-
	Hornbrook, Siskiyou County.....	1910-
	Sacramento.....	1911-1913
Klamathon Egg Collecting Station.....	Brookdale, Santa Cruz County (operated by state).....	1912-
Sacramento Experimental Salmon Hatchery.....		
Brookdale Hatchery (operated by county, 1905 to 1912).....		
Scott Creek Egg Collecting Station (operated by county, 1905 to 1912).....	Scott Creek, Santa Cruz County.....	1912-
Willow Creek Egg Collecting Station.....	Thrall, Siskiyou County.....	1912
Camp Creek Egg Collecting Station.....	Siskiyou County.....	1912-

HATCHERIES AND EGG-COLLECTING STATIONS, 1870-1921—Concluded.

Name	Location	Years of operation
Bear Lake Fish Hatchery.....	Big Bear Lake, San Bernardino County..	1914-
Gottville Egg Collecting Station.....	Siskiyou County.....	1914
North Creek Egg Collecting Station.....	Big Bear Lake, San Bernardino County..	1915-
Burney Creek Egg Collecting Station.....	Near Burney, Shasta Co., on Pit River.....	1915
Ward Canyon Egg Collecting Station.....	Copeo, Siskiyou County.....	1915
Fort Seward Hatchery.....	Alderpoint, Humboldt County.....	1916-
Marlette-Carson Hatchery.....	Carson City, Nevada (operated by California Fish and Game Commission)....	1916-1917
Almanor Fish Hatchery.....	Almanor Dam, Plumas County.....	1916-1919
Yuba City Experimental Shad Hatchery.....	Yuba City, Sutter County.....	1916
Domingo Springs Hatchery.....	Chester, Plumas County.....	1916-
Rae Lakes Egg Collecting Station.....	Rae Lakes, Fresno County.....	1917-
Bryan's Rest Egg Collecting Station.....	Bryan's Rest, Humboldt County.....	1917
Mount Whitney Hatchery.....	Independence, Inyo County.....	1917-
Yosemite Experimental Hatchery.....	Yosemite, Mariposa County.....	1918-1920
Cottonwood Lakes Egg Collecting Station.....	Cottonwood Lakes, Inyo County.....	1918
Clear Creek Hatchery.....	Westwood, Lassen County.....	1918-
Feather River Experimental Hatchery.....	Grey Eagle Creek, Plumas County.....	1918
North Creek Hatchery.....	Big Bear Lake, San Bernardino County..	1919-
Fall Creek Hatchery.....	Copeo, Siskiyou County.....	1919-
Kaweah Hatchery.....	Hammond on Kaweah River, Tulare Co..	1919-
Metcalf Creek Egg Collecting Station.....	Big Bear Lake, San Bernardino County..	1919-
Bull Creek Egg Collecting Station.....	Dyerville, Humboldt County.....	1919
Grout Creek Egg Collecting Station.....	Big Bear Lake, San Bernardino County..	1919-
Warner Creek Egg Collecting Station.....	Plumas County.....	1920
Eel River Egg Collecting Station.....	Branscomb, Mendocino County.....	1920-
New Tahoe Hatchery.....	Tahoe City, Placer County.....	1920-
Feather River Hatchery.....	Johnsville, Plumas County.....	1921-
San Joaquin Experimental Station.....	Auberry.....	1921

FISHCULTURAL DEPARTMENT PERSONNEL.

By HAROLD C. BRYANT.

The fishcultural work of the state gained its initial impetus from the first commissioners, appointed in 1870, Messrs. B. B. Redding, S. R. Throckmorton and J. O. Farwell. Because of their interest in stocking the streams with desirable food fishes, the hatching and rearing of fish received due encouragement. The first fishculturist retained by the commission was Mr. J. G. Woodbury, who had been carrying on experiments in fish breeding for the California Acclimatization Society, and later for the United States Fish Commission. Mr. Woodbury devoted nearly twenty years of his life to the interests of fishculture in California. His principal work was done at Berkeley and San Leandro, where trout and salmon were reared, and at Clear Lake station, where the propagation of whitefish was attempted. Mr. Woodbury became first assistant to Dr. Livingston Stone at the time the government salmon-breeding station on the McCloud River was established in 1872. He was made State Superintendent of Hatcheries in 1888, and during the same year, with the assistance and advice of Dr. Livingston Stone and United States Commissioner Marshal McDonald, he located the Sisson Hatchery. The following year he located the hatchery at Tahoe City.

In 1891, desiring to engage in private business, Mr. J. G. Woodbury resigned as superintendent of hatcheries. In 1893, the board appointed Mr. John P. Babcock to fill the newly created position of chief deputy of the California Fish Commission, in which capacity Mr. Babcock acted from 1893 until 1901, when he resigned to accept a position with the government of British Columbia.

The successful transportation of eggs and fry from Eastern states in the seventies was due to Dr. Livingston Stone, a fishculturist of the United States Fish Commission. On each of the several difficult trans-continental trips Dr. Stone proved that he understood the care of fish. As much of acclimatization work was a cooperative project by the United States Fish Commission and the California Fish Commission, Dr. Stone was at times under the employ of the California commission. This was true also when he became superintendent of the McCloud River Hatchery, for the California commission bore a portion of the cost of hatching and planting the salmon.

Mr. J. A. Richardson, who had been employed by the United States commission at the Baird Hatchery, and who was an assistant at the San Leandro Hatchery, was made Superintendent of the Shebley Hatchery when it was built in 1883. Mr. Richardson resigned in the fall of the same year, and Mr. I. C. Frazier was appointed to succeed him. Mr. Frazier was a successful and competent fishculturist, who had been a student of fish life for a great many years. In the early seventies he associated himself with some of the acclimatization societies and later established a hatchery, with rearing ponds, on the Truckee River. In 1884, owing to ill health, he resigned as superintendent of the Shebley Hatchery, and Mr. J. V. Shebley was appointed superintendent. In 1885, Mr. J. V. Shebley was appointed Superintendent of Hatcheries, and Mr. W. H. Shebley succeeded him at the Shebley Hatchery. Mr. Frazier later became superintendent of the Tahoe Hatchery, and Mr. Richardson was again employed as an assistant.

When the Sisson Hatchery was built, in 1888, Mr. J. A. Richardson was appointed superintendent, and he managed the station until 1893, when Mr. W. H. Shebley succeeded him. The largest hatchery in California, and in some respects the largest in the United States, was for twenty-one years under the efficient supervision of Mr. W. H. Shebley. As superintendent he demonstrated that millions of trout could be successfully reared each year without serious loss.

The pioneer work of introducing the first shipments of trout in the barren waters of the Yosemite region was carried on by Mr. Shebley, who introduced the first fish in the waters above the valley in 1892.

In November, 1911, the commission created the office of fishculture and distribution, and Mr. Shebley was assigned to this new division of the work. A successful organization of this department was soon accomplished, with the division of screens and fishways, as part of the department of fishculture. As the duties of this work required Mr. Shebley to be away much of the time, Mr. R. W. Requa was made assistant superintendent of the Sisson Hatchery, and he very ably assisted in conducting the work of the station. Being a skilled mechanic, Mr. Requa invented and perfected the rotary type of screen used in irrigation ditches.

The success of early experiments and the efficiency of the present fishcultural department have been due largely to the untiring care and energy of Mr. W. H. Shebley. There is no one in America who possesses greater knowledge of fishcultural methods. Present fishcultural methods and the system of rearing ponds installed at the Mount Shasta Hatchery will always be a monument to his ingenuity.

On March 1, 1916, the office of the department of fishculture was transferred from Sisson to San Francisco. Extensive fishcultural operations demanded a more centrally located section. Mr. E. W. Hunt was appointed field superintendent of the department of fishculture, and Mr. J. H. Hoerl chief clerk. Mr. Shebley was succeeded as superintendent of the Sisson Hatchery by Captain G. H. Lambson, who for seventeen years was superintendent of the United States Bureau of Fisheries stations in California.

The hatcheries at Lake Tahoe were for twenty years under the supervision of Mr. E. W. Hunt, who is a fishculturist of long standing and a man of keen business ability. The results of his management are evident now in the well-stocked lakes and streams of the region. Since 1916 Mr. Hunt, as field superintendent, has done most of the inspection and advisory work at the various hatcheries.

The work at Ukiah was for many years very capably handled by Mr. A. V. La Motte.

For many years Mr. M. L. Cross had charge of the Wawona Hatchery and directed the distribution that has placed trout in hundreds of miles of streams and thousands of acres of lakes in the previously barren areas lying above and beyond the Yosemite Valley. As a hatchery man, his work was always above criticism.

For many years previous to his death in 1918, Mr. F. A. Shebley was a trusted fishculturist of the commission. He was the son of California's first famous fishculturist, and had succeeded before his death, in company with his brother, William H. Shebley, in making a reputation in the same line of endeavor as great, if not greater, than that of the father who had gone before. As a boy he followed farming on his father's place, but for twenty-five years he was identified exclusively with fishculture in connection with the California Fish and Game Commission, and there were few men on the Pacific slope who knew as much about fish and fishing in the waters of the rivers and bays as he. At various times he was superintendent of the Price Creek hatchery in Humboldt County and the Brookdale Hatchery in Santa Cruz County, and later the new Mount Whitney Hatchery in Inyo County. Under his management the Brookdale Hatchery became very popular and was sought out by sportsmen from all over California as a place of great interest. Also interested in angling as a sport, he was a master of the fly rod and a skilled angler.

In 1900 Mr. W. O. Fassett was appointed superintendent of Eel River Hatchery, and under his management the station was a continued success. In more recent years Mr. Fassett has had charge of all of the fishcultural operations along the north coast.

In October, 1901, Mr. Charles A. Vogelsang was appointed chief deputy of the California Fish and Game Commission, following the resignation of Mr. J. P. Babcock. During the administration of Mr. Vogelsang as executive officer of the commission (1901-1910) a number

of practical improvements were put into effect; the Sisson and the Tahoe stations were enlarged and improved; the hunting license law was passed, which placed at the command of the commission an increased amount of funds that could be devoted to the propagation and protection of the fish and game; the fish-distributing car was built; the game farm was established, and other improvements were made. In the carrying out of all of this work Mr. Vogelsang took an active part. He resigned in 1910, but was reappointed executive officer in 1920 and held that position until March, 1922.

There have been many other faithful hatchery employees, but their years of service have been more limited.

THE RETURN OF MARKED KING SALMON GRILSE.

By J. O. SNYDER, Stanford University.

Twenty-three marked king salmon grilse were taken at the Klamathon racks last fall. This is the first result of a marking experiment initiated in 1918 by W. H. Shebley, in charge of fishculture. A complete account of the marking of these fish, as published in CALIFORNIA FISH AND GAME, July, 1920, may be summarized here. From king salmon eggs taken in Mill Creek, a tributary of the Sacramento River, in November, 1918, and hatched at Fall Creek Hatchery on Klamath River in February, 1919, 250,000 fish were placed in a rearing pond. In November, 1919, these were liberated in Klamath River, after 25,000 of them were marked by removing the adipose and right ventral fins (Fig. 40). It appears that the marking was successfully accomplished and that the fish were liberated under the best conditions. Some of these were expected to return as grilse in 1921, and later as older fish.

The marked fish appeared at Klamathon, where they were stopped by the racks, from October 24 to November 14, when the last one was taken. Of the last ones secured, Captain Lambson remarks, "Two were in very fine condition, as if lately from salt water." These fish measured from $15\frac{1}{2}$ to $24\frac{1}{2}$ inches to the end of the middle caudal rays. All were mature males.

Scales of these marked fish, together with mutilated fins, were carefully preserved by E. V. Cassell, foreman of the Fall Creek Hatchery. This material and a considerable amount of necessary data were assembled and forwarded to the writer by Captain G. H. Lambson. Therefore the record of each specimen is accurate and complete.

A photomicrograph of a scale of one of these grilse is here presented as figure 43. An examination of this scale will reveal some peculiarities of structure. It will be seen that a well-defined inner part or nucleus, A, is composed of 11 or 12 concentric rings or circuli, which are closely apposed and in some places broken or branched. Outside the nucleus and surrounding it is a broad area of more-regularly formed circuli, which are at the same time much wider. This area, which may be designated A-D in the figure, is bounded at D by a crowded condition of the circuli. Beyond this area is a third region, D-E, the circuli of

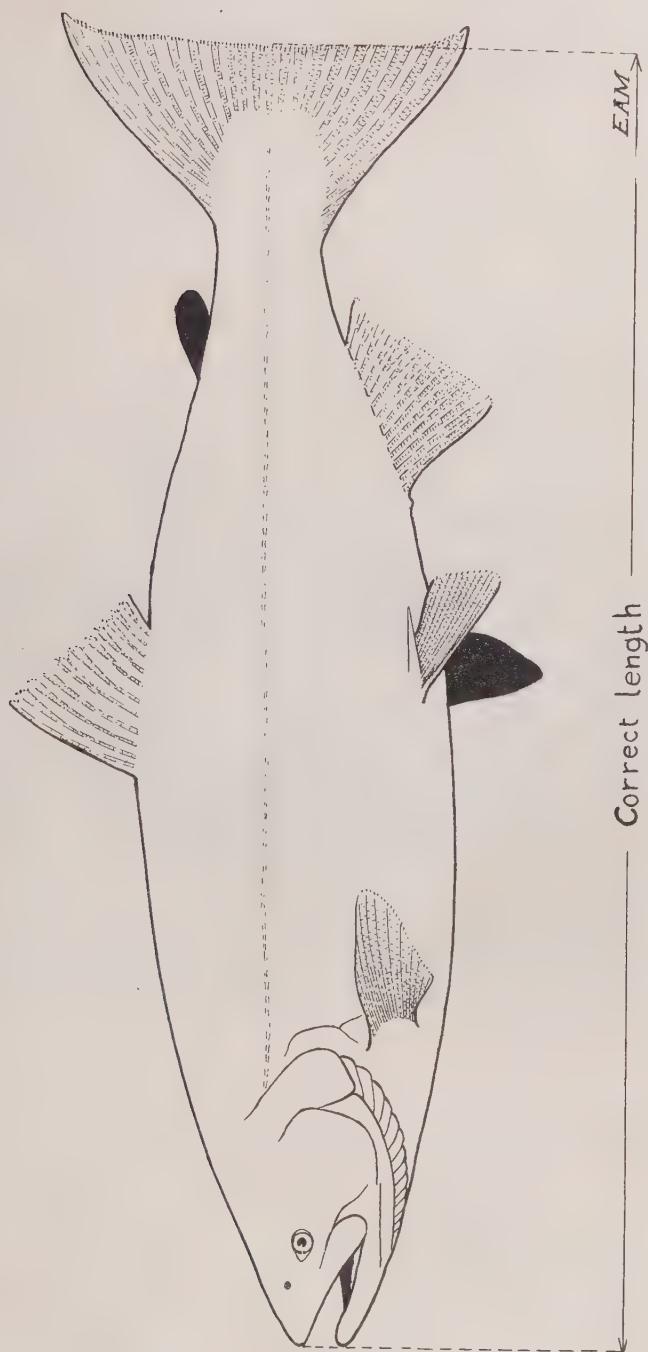


FIG. 40. Outline drawing of king salmon, showing method of marking in experiments by the removal of the adipose and the right ventral fins.

which are still wider than the others. This region extends to the edge of the scale, which is rough and broken. In the area marked A-D the circuli are not altogether homogeneous in character, for at B and also at C, two or three of them are closely apposed or narrower than the others. These are the principal structural features of this particular scale.

Scales from the other marked grilse possess very similar characteristics. These present the same type of nucleus, which is surrounded by two distinct outer areas, the inner of which is much like that of the scale just described. The nucleus, when followed through the entire series of 23 scales, is seen to possess the same closely crowded or narrow circuli, although they vary in number from 8 to 14. The area designated



FIG. 41. The racks at Klamathon, between which the returning grilse were trapped. Photograph by E. A. McGregor.

as A-D is in cases wider or narrower, but it preserves more or less definitely the same features. The outer area, D-E, varies greatly in width, in some cases being scarcely represented. The irregular edge and the variable width of this outer area are due to absorption which the scale has undergone, it having suffered as have some other tissues of the body during the long and difficult migration from the sea, which was performed without food. In grilse taken at the mouth of the river this portion of the scale is perfect, as is illustrated by figure 44.

It will be of interest to attempt an interpretation of some of the structural features which are apparent in these scales, even in the face of the possibility that such interpretation may not be wholly supported by additional data which it is hoped the future will provide. In the

first place, we know that the fish is in its third year, and by the application of the well-tested criteria of investigators of scale growth, it may be safely stated that the nucleus represents roughly the growth of the first year, the area A-D that of the second, and D-E the third, a part of the latter having been effaced by absorption.

The nuclear growth record as traced in these scales is exactly duplicated by that of scales removed from some small yearlings of the same lot at the time of their liberation. Such scales are represented by figure 46.

The nucleus of the scale represented by figure 43 is much like that of a naturally spawned fish which has spent its first year in the river.



FIG. 42. Spawning operations at Klamathon. E. V. Cassell, taking eggs from a female king salmon. Photograph by E. A. McGregor.

A scale that is believed to be of such an individual is represented by figure 44. This type of nucleus is very different from that of a salmon which entered the sea at an earlier period in its life, near the time that scales make their appearance. A scale of such a fish which was taken in its third year is shown in figure 43, where the first year's growth extends to A.

Attention was directed to the lack of homogeneity in the area A-D, which is presumed to represent the growth history of the second year. Two very evident intermediate checks appear, one at B, the other and later one at C. The area enclosed by the check B is composed of circuli which are somewhat narrower than the others, possibly characteristic of slower growth. It might be presumed that this area is one of river growth, attained while the fish lingered in the estuary, where food

abounds. It is not strictly characteristic of estuary growth, however, as illustrated by fish taken at or near the mouth of Klamath River. In the latter part of August, and probably much earlier, yearling salmon appear in the estuary, where they linger and grow very rapidly. Some specimens measuring 200 millimeters and looking much like miniature salmon from the sea were collected in September. A scale from one of these is shown in figure 47. In this scale a nucleus, A, is apparent, which is surrounded by an area of wider circuli. From facts learned from observation of these fish, this region is undoubtedly representative of estuary growth, and a comparison of this with the area A-B would scarcely lead to a similar interpretation for the latter. It seems more probable that after being liberated this fish hastened on his long journey to the sea, growing very little, if any, on the downward passage.

While in the sea during the second year, two checks in growth occurred, due to what cause we have no means of knowing. Near the end of the second year a check normally appears. This is represented at D. Abundant material from Monterey Bay shows that this check usually develops in the winter or early spring, not appearing in all individuals at the same time.

The intermediate checks offer nothing remarkable, as somewhat similar characters may be easily found in any large assemblage of king salmon scales. They might be passed over as indicating that some event in the life of the fish, temporary scarcity of food, for example, had served to interrupt or check its normal growth at a particular time. But in this they deserve further consideration, as will appear.

Of the twenty-three marked salmon which were recovered, no less than seventeen possessed scales which in every essential detail were like that illustrated in figure 43. That the nuclei should be much alike occasions no surprise, for all were reared alike, and consequently environmental conditions were similar for all while the nuclear growth progressed, but that this detailed resemblance should continue in such a marked way through the second year is worthy of attention.

Under an hypothesis that the growth of the fish is reflected by the growth of the scale, and that growth is influenced by environment, the assumption follows that all of these fish must have been in contact with the same environmental conditions during the second year. It would appear not at all improbable that they schooled together. This suggests the possibility that associations formed in the stream may continue in a large measure throughout life in the sea. The four-year fish of this marking, if any are caught, will furnish additional data of interest in this connection. They will also bring a record of the third year, which in these grilse is largely effaced.

Scales of the remaining marked fish differ in a minor degree only from the others by having a more or less well-defined check about half way between those marked B and C in figure 43.

As 250,000 fish were liberated, of which 25,000 were marked, the return of ten unmarked individuals with every marked one might be expected. Unfortunately, scales were preserved from very few unmarked grilse while the marked ones were being taken. However, among those that were preserved are two which show the same characteristic scale structure as the marked ones. A photomicrograph of one

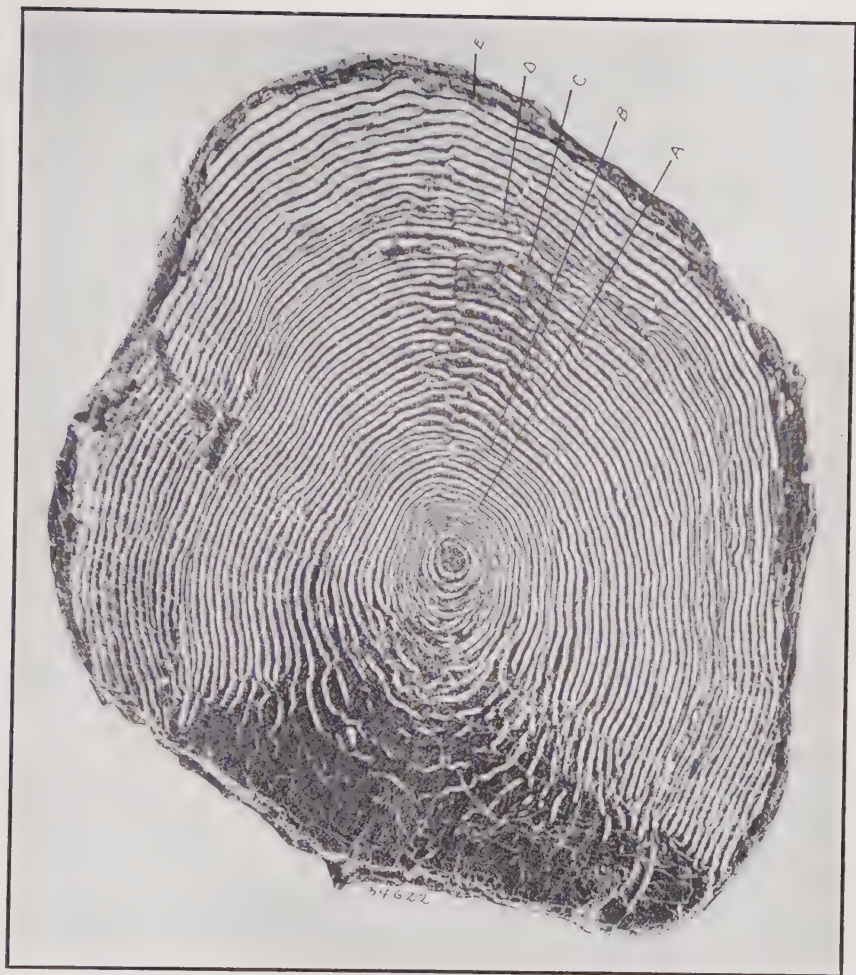


PLATE I.

FIG. 43. Photomicrograph of a scale of a marked king salmon grilse which returned to Klamathon racks in 1921.

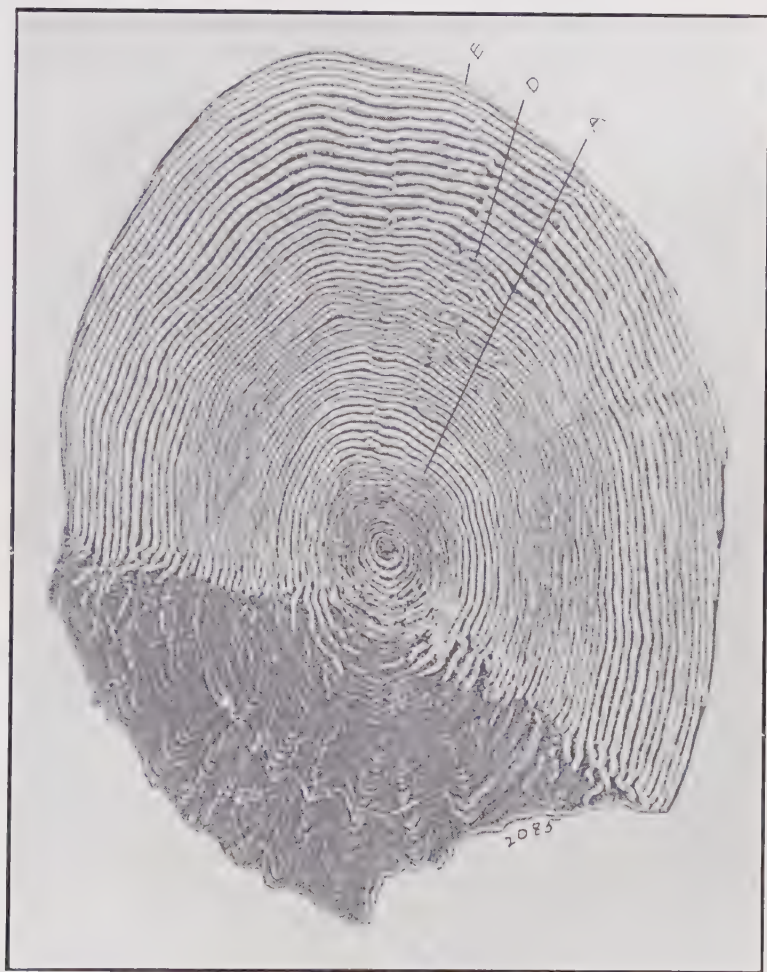


PLATE II.

FIG. 44. Scale of a male king salmon in third year. From Klamath Estuary.



PLATE III.

FIG. 45. Scale of a male king salmon in third year; ocean type of nucleus.

FIG. 46. Scale of a yearling king salmon 84 millimeters long. One of a marked lot of fish which was preserved at the time the others were liberated.

FIG. 47. Scale of a yearling king salmon measuring 200 millimeters, showing estuary growth.

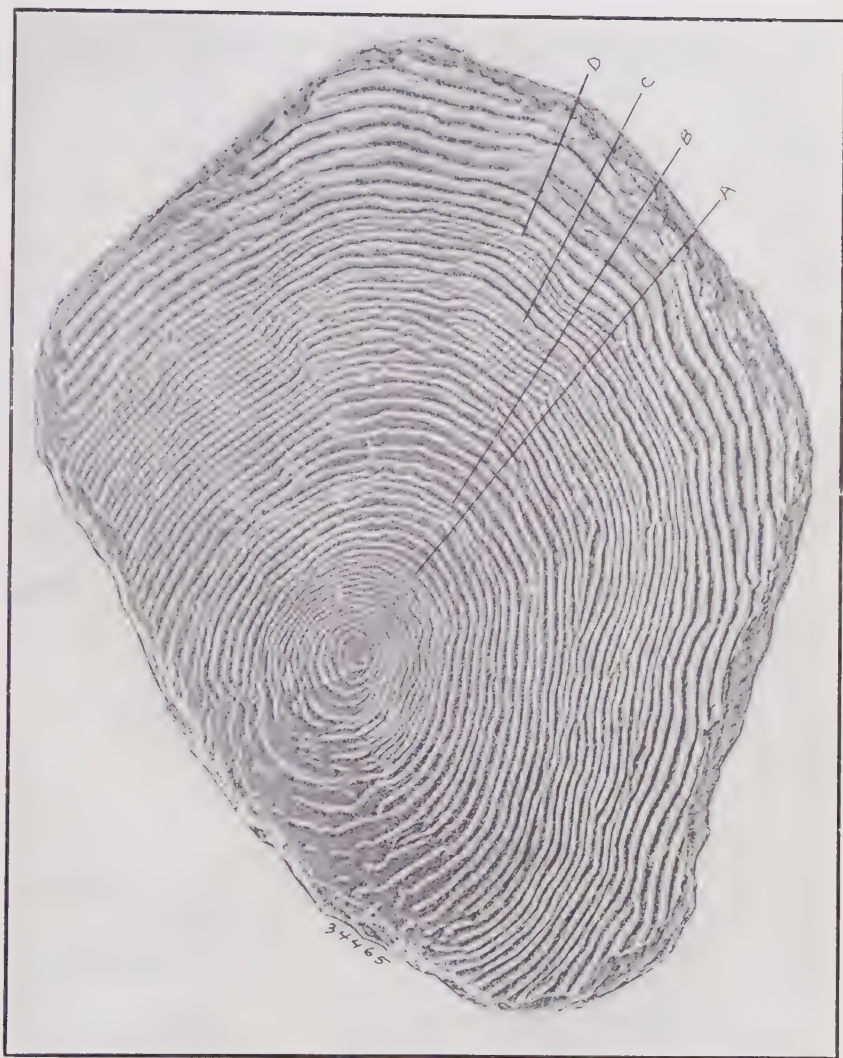


PLATE IV.

FIG. 48. Scale of an unmarked grilse which was liberated with marked ones in Klamath River.

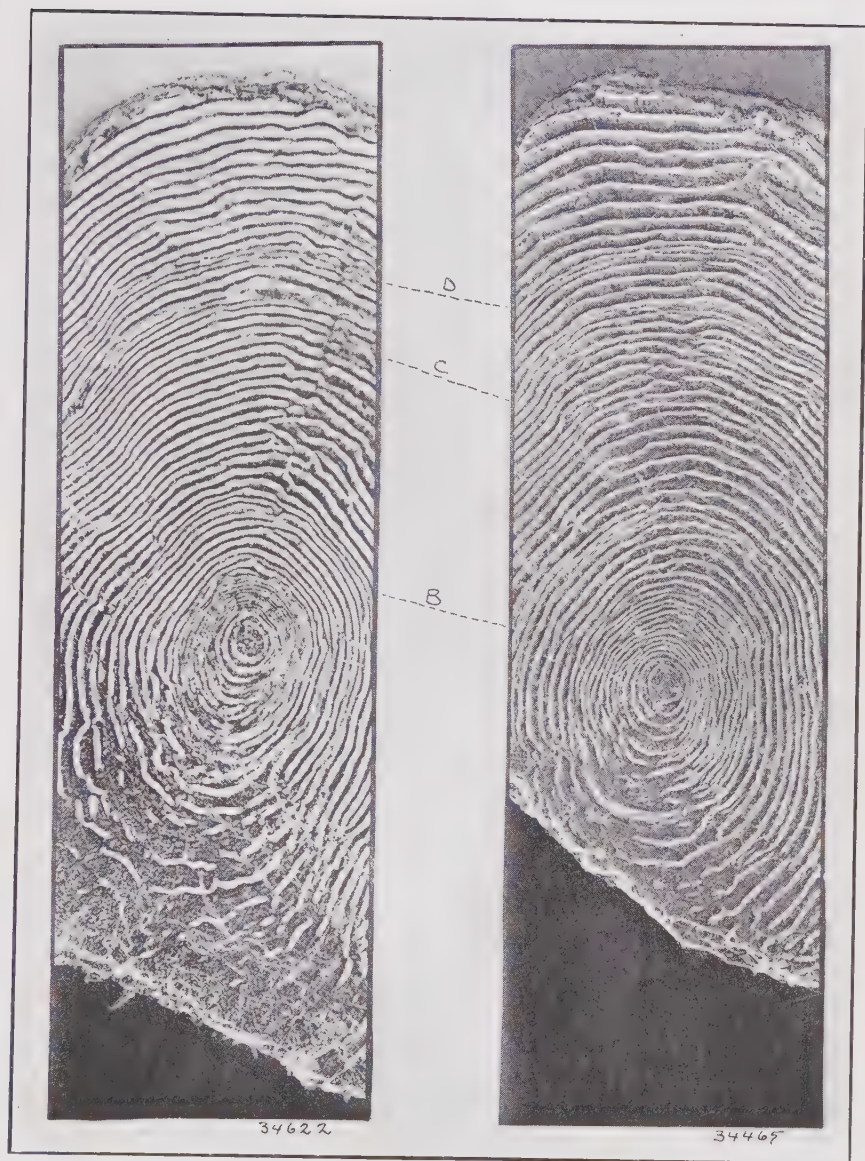


PLATE V.

FIG. 49. Scales of marked (34622) and unmarked (34465) king salmon grilse which returned to Klamathon racks in 1921.

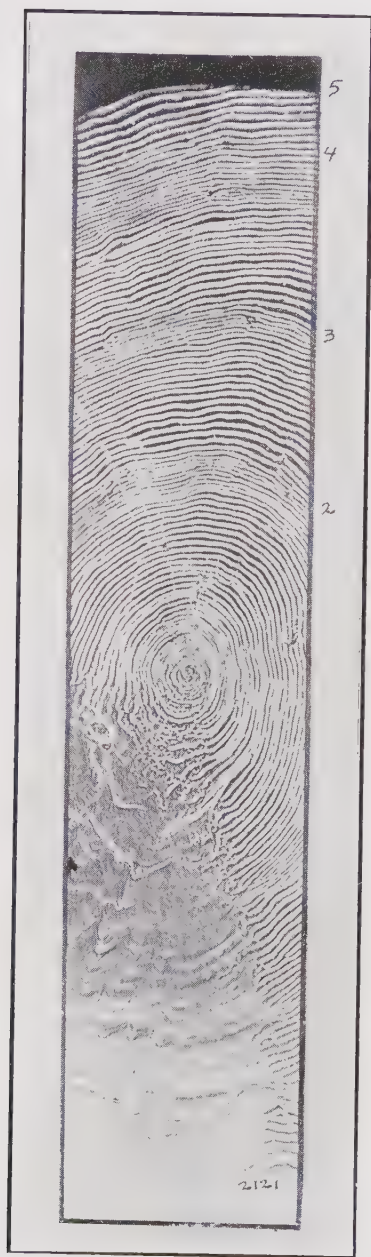


PLATE VI.

FIG. 50. Scale of a five-year-old marked king salmon recovered in Klamath River in 1919.

is shown as figure 48. A comparison of this with figure 43 is made easy in figure 49, where selected parts of each are placed side by side. There is here demonstrated the possibility of recognizing unmarked fish which are liberated with marked ones, providing all were treated alike, and this will warrant the close scrutiny of a great many four-year fish which enter the Klamath a year hence, especially at the Klamathon racks, where all that escape the vicissitudes of sea and river may be expected to arrive.

In 1919 a single marked fish was obtained in the Klamath estuary as the only result of an experiment initiated in 1916. An account of this experiment reads as follows (CALIFORNIA FISH AND GAME, Vol. 2, No. 4, p. 209): "On February 15, 1916, 3500 marked yearling quinnat salmon were liberated in the Klamath River at Klamathon. They were hatched at the Sisson Hatchery from eggs taken on Butte (meaning Battle) Creek in November, 1914. Each was marked by removing the left ventral and the adipose fin. It is expected that a few of these will be recovered in the Klamath River in 1917 as male grilse, and that both males and females will be taken in 1918, 1919 and 1920 as 4, 5 and 6-year-old fish." The single fish recovered was first observed by Henry Jackson, an employee in the cannery of the Klamath River Packers Association at Requa, August 29, 1919. The specimen was presented to an agent of the Fish and Game Commission by Mr. G. R. Field. It measured 43 inches and weighed 35 pounds. Its age is plainly shown by the character of one of its scales in figure 50. Because of unfortunate circumstances, no very definite effort was made to recover marked fish from this experiment until it was almost too late, and the very meagre results serve to illustrate the futility of initiating an experiment when not fully prepared to closely follow it up.

The experimental planting of 1919 now gives promise of unusually good results, and no reasonable effort should be spared to secure full data relating to it. Fish bearing its mark may appear along the coast in the catches of trollers, and thus offer some evidence relating to the contribution of Klamath salmon to sea fisheries. It is known that Klamath fish are caught at sea, as salmon on entering the river bring from time to time mute evidence in the form of embedded hooks, and even entire spoons, which look like those used in sea trolling to the southward.

This particular experiment is part of an effort of the Fish and Game Commission to accumulate facts relating to the habits and distribution of the king salmon which shall contribute toward the conservation and maintenance of the fishery. It is of interest to fisherman, dealer, packer and consumer alike, and no opportunity should be lost to contribute to its results. Any one so fortunate as to catch one of these fish should make an accurate note of it. He should measure its length from the snout to the end of the middle part of the tail (see figure 40), determine its sex, cut the mutilated fins from the body, including a liberal piece of skin, scrape a hundred or so scales from near the middle of its side, write down the date and exact locality of capture, the name and address, and mail the entire data to the Fish and Game Commission. The fins should be well salted, and the scales may be spread out between two papers.

THE WHY AND HOW OF MOUNTAIN LION HUNTING IN CALIFORNIA.

By JAY BRUCE, State Mountain Lion Hunter.

The importance of the control of the mountain lion (*Felis concolor*) as an aid in game-conservation can be appreciated when it is realized that the present lion population of California is scientifically estimated to be about 600 lions, and their annual kill of deer 30,000 head. This is over twice the number known to be killed by human hunters. Since does are probably about five times as numerous as bucks, a lion has five chances to kill a doe for one chance to kill a buck. So, naturally, most of the deer killed by lions are the breeding stock of females.

Although deer form their principal food, lions also kill thousands of dollars worth of domestic stock every year, even including full grown cattle. In fact, no animal in California is entirely exempt from the bloodthirsty instincts of these animals. I know definitely of lions having killed and eaten foxes, skunks, coons, porcupines and bobcats. I also have reliable information of several instances where lions have killed and eaten domestic dogs, while two lions now in captivity in the Yosemite Valley killed and ate a cub bear which managed to get into the lions' cage from his own adjoining cage.

The lion problem has been intensified by the establishment of a chain of game refuges where no public hunting is allowed. The breeding stock of deer and other game is fast increasing in these areas, and naturally the lions accumulate there. Since the lion's instinct is to kill at every opportunity, the most damage will be done where deer are most numerous.

In order to meet this condition a high state bounty was advocated. It seemed doubtful, however, whether a \$100 bounty would attract enough hunters to confer a benefit anywhere in proportion to the additional cost, as will be shown later. Another method of control considered was the employment of experienced lion hunters on a regular salary, plus the present bounty. As an experiment along this line the writer was employed by the California Fish and Game Commission, on January 1, 1919. This system costs only about \$2000 per year, as against the \$15,000 by the increased bounty, and lions are killed where there is the most need of killing them. The main object of the plan adopted was to control the lions in game refuges, and then to answer any calls where lions were doing unusual damage. During the last three years I have accounted for ninety lions, as follows: 1919, twenty-six lions; 1920, thirty lions; 1921, thirty-four lions. Most of these were taken in and around game refuges. Since October, 1908, the California Fish and Game Commission has been paying a bounty of \$20 for each mountain lion killed. Claims for such bounty are made on blanks furnished by the commission, and every claimant has been requested to furnish the commission with a written statement showing where the lion was killed, why it was killed, the damage done by the

NOTE.—There have been few articles appearing in CALIFORNIA FISH AND GAME of more general interest than the one offered here, written by a man who probably knows more about the habits of the mountain lion than any other Westerner. In bagging 121 lions, Mr. Bruce has traveled on foot over 10,000 miles, hunting, tralling, and studying their habits.—EDITOR.

lion, methods used in taking him, and the sex of the animal. In July, 1917, the bounty on female lions was raised to \$30 per head.

The information sent in by claimants for bounty indicates that nearly all of these lions were killed either accidentally or because they were doing damage to stock, and not on account of the bounty. Now if the bounty were raised to \$100 per lion, the state would be paying \$75 more on an average for each lion now killed under the present bounty, and this would amount to about \$15,000 annually.

From the foregoing it might be argued that the present bounty is useless and should be abolished, so let us examine and see what benefit

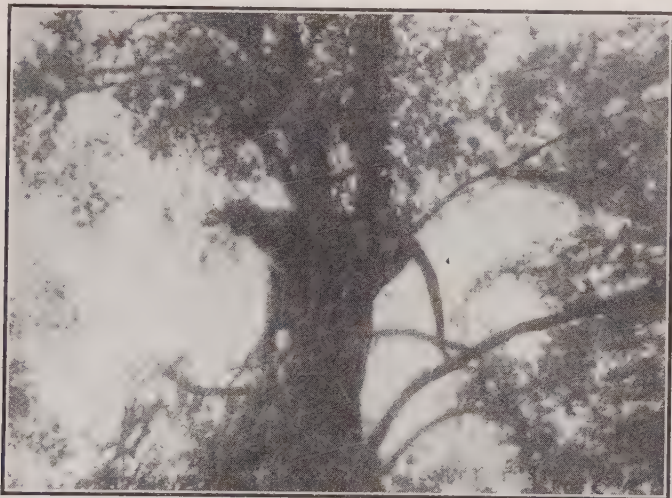


FIG. 51. One hundred and fifty pound male lion treed near Lynchburg ranger's station, Placer County, November 1, 1921.

is derived from this expenditure. It is evident that no situation can be handled intelligently or with efficiency without accurate data as a basis for action. Now on account of the bounty of \$20 paid since 1908, the commission has been furnished with the following data:

The number of lions killed during the last thirteen years;

The proportionate number of these killed from year to year under a given condition, which should indicate the comparative lion population;

The damage known to have been done by each lion;

The methods used in taking the animal;

The percentage of each sex killed since 1917.

These data are of immense value in any effort to control the lion, and are now being used to advantage for that purpose by the commission. For instance, we find from an examination of these data that the range of the lion on the western slope of the Sierra Nevada Mountains between Siskiyou County and Kern County, is confined to a straight belt about fifteen miles wide by section lines, and at an elevation between 3000 and 5000 feet above sea level and averaging 4000 feet. The same elevation will apply to the range of the lion in the Coast

Range Mountains. All the country above or below this belt can be eliminated as lion country for all practical hunting purposes.

The lion does not habitually follow some of the deer to the foothills in winter, as many people suppose. This lion belt is so well defined in the Sierra that we can draw a straight line through the center of the belt, from a point in Siskiyou County to a point in Kern County, and it would be possible for a hunter to camp along this line and kill approximately every lion on the western slope of the Sierra. Of course a lion will occasionally stray out of this belt temporarily, but he soon returns, for his natural home is there. The lion probably selects this belt because it is the natural home of the deer. The variety of *ceanothus*, commonly



FIG. 52. A large 160-pound male lion which measured 7 feet 3½ inches. Killed near Avery, Calaveras County, in March, 1921. Photograph by L. V. Peterson.

called deer brush, which is the principal food for deer, grows in abundance in this belt between 3000 and 5000 feet elevation. The deer that summer higher winter here, and those that winter below summer here. Most of the deer stay here all the year, so this area is the best all-year range for them. In other words, the maximum deer population is to be found in this area. For this reason the lioness selects some place in this belt when her young are to be born. She usually has two or three kittens, although sometimes only one, and occasionally four, are born in a litter. On account of many females not mating every year, the yearly increase probably averages one kitten for each adult female. The lair is usually located around some bluff or pile of rocks, which furnishes places for shelter and concealment of the kittens when small.

In my experience, the kittens are born in either February, April, August or November. The mother nurses them for about two months, and probably brings them some food in her stomach during that time.

After they are weaned she makes a kill and moves the kittens to it, leaving them to eat it while she goes away hunting. She continues moving the kittens from kill to kill until they are about six months old and weigh about 35 pounds for females and 50 pounds for males, by actual scale weight. They now hunt part of the time with their mother until they are about a year old and weigh about 65 pounds for females and 80 pounds for males. The mother then abandons them. The kittens sometimes continue to hunt together for a few months longer, when they finally separate, selecting different beats, but still in the same belt where conditions are the same as where they were raised.

When fully matured the male weighs from 140 to 160 pounds and measures from $6\frac{1}{2}$ feet to $7\frac{1}{2}$ feet from tip of nose to tip of tail. The female weighs from 90 to 105 pounds and measures from 6 feet to 7 feet from tip to tip. These are actual scale weights and tape measurements.

The adult male accompanies the female only during the mating period and does not help to feed and care for the young. Lions do not make their kills by lying in wait on the limbs of trees and springing from there. In fact, I have never known of a lion climbing a tree except to avoid the dogs. They tirelessly hunt and stalk their quarry on the ground, taking advantage of every cover, and finally rushing from a distance of 40 or 50 feet. This distance is covered in about a second. A 100-pound lion moving at a velocity of 40 feet per second will strike a blow sufficient to prostrate a yearling steer. The heavy muscles of the lion's neck, shoulder and forepaws are tense for the blow, and easily absorb the shock that prostrates his unsuspecting victim, which is then killed by being disemboweled. The liver is eaten first, and then the loins and hams. An examination of probably 100 deer killed by lions showed no evidence of the lion having touched the throat of any of these kills.

I have found the lion to be normally a solitary and invariably a silent animal. I have never heard that hair-raising scream the lion is supposed to utter, and I do not believe it makes any loud sounds, but that the noises usually attributed to it are made by owls and coyotes. On one occasion of which I know, about fifty guests at a mountain resort were listening one evening to the braying of a mule colt, and were told in good faith that they were hearing a mountain lion scream. Every one of these people, including their informant, probably believes to this day that they were hearing a lion.

Some writers have condemned the mountain lion as being cowardly and unwilling to attack in the open, but they lose sight of the fact that the cat family is short-winded and unable to capture its prey by running it down as the dog family does. If the lion should openly approach his prey and challenge it to combat, his intended victim would immediately take to flight, leaving the lion to go hungry. His only means of making a living is to surprise his quarry. In a fight to the death, the mountain lion is more game than the black bear. He will fight with his last breath, when the black bear will quit and cover his head with his paws and bawl like a calf.

The most reliable method of taking lions is trailing with dogs, and the best dogs for this purpose are fox hounds. A hunter requires at least four dogs, which must be highly trained on lions and thoroughly proof on deer and other game, as there are probably a thousand head

of deer and other game combined, for each lion. The dogs are used in pairs, allowing each pair to rest every second day, as a dog uses so much energy in running, baying and wagging his tail during ten or twelve hours of trailing that he needs one day's rest for each day of work. Furthermore, a dog's feet will not stand continuous hunting.

To be successful, lion hunting must be done intensively. Since a lion does most of his prowling at night, the hunter must leave camp early and travel fast, in order to find a fresh trail and have the most hours of daylight to trail the lion down, as a person can neither travel to advantage in the mountains after dark, nor see tracks when necessary to help the dogs. A lion travels a regular beat over about 100 square miles, usually making his round about every four or five days, so as soon as some part of this beat is learned, the hunter has a clue to



FIG. 53. Mountain lion scratches.

work by. Since the dogs can smell only a reasonably fresh track, the hunter can not depend entirely upon their sense of smell to find the trail, but must always watch the ground carefully for any old signs which would indicate the places where a lion had been traveling.

The signs left by lions are fresh or old kills, dung and tracks, and if a male is traveling a beat the plainest sign will be marks about a quarter to a half mile apart along the beat and apparently made by the lion digging with his forepaws in the dead leaves near the base of a tree or in the rotten wood near an old log (see figure 53). These marks are all alike and can not be mistaken for anything else when once learned; they are made only by the male and are a sure indication to

the hunter of the sex of the animal he is trailing. After some part of the lion's beat has been learned, that part must be hunted first every day, continuing the hunt then from there. If one day is missed and the lion passes, the track may be too old for the dogs when it is found the next day, and this may mean four or five days before the trail is again found fresh enough for the dogs to follow. A dog can not follow any but a very fresh trail on hot and dry ground or in dust, so the hunter must use his eyes to help the dogs past such places. In the cool, damp weather of winter a twenty-four hour trail can usually be successfully followed, while in the hot, dry weather of summer a six-hour trail is found difficult. When snow is on the ground, trailing is



FIG. 54. Doe and fawn killed by mountain lion near Bear River on north fork of Mokelumne River.

easy and a four or five-day-old track should be followed, as a lion may make a kill at any point on his beat and may have returned for a feed, allowing the hunter to get a fresh track at the kill. I estimate that while killing 120 lions I advanced an average of about fifteen miles the day the lion was killed. This distance does not take into account many loops made in looking for tracks when it was necessary to help the dogs. Many times I have trailed a lion this distance each day for three or four days before bagging him. Several times I have advanced twenty-five miles, and once thirty miles, the day I got the lion. Generally the hunter travels on foot over 100 miles for each lion killed. I estimate that on the average trail my dogs will travel about five times the distance advanced. To me it is very interesting to watch a hound on the trail. He rushes along with nose close to the ground, head sweeping from side to side and tail wagging furiously, stopping suddenly as he catches the scent, smelling intensely for a moment to make sure, then throwing up his head and baying loudly as he rushes ahead for a hundred feet or so, then trying again for the scent, and circling until the trail is located. Now another rush ahead, and so on for twelve or fourteen hours, or until the constant baying indicates that

the lion has been routed out of his bed and is making away, with the dogs in close pursuit. The hunter knows when the lion is finally treed, by the changed note in the baying of the dogs and by the fact that the baying comes continually from one place. On arriving at the tree, he can see anywhere from 100 to 160 pounds of cat, standing among the branches, usually about 30 feet above the ground. The lion may be just watching the dogs with interest, or he may be very angry, which is indicated by his constant growling.

At the crack of the gun, out he goes, and even though shot through the heart he may still be able to seriously injure a dog. For this reason it is best to tie the dogs before shooting.

It is quite an exciting experience to see a wounded adult lion on the ground, trying to hold at bay from two to four frantic dogs. Every moment will be full of action, as the dogs attack from different directions and the lion continually turns to meet each attack. All the while he is growling and spitting savagely, his ears flat back, mouth wide open, claws unsheathed and hair and tail standing up. If the dogs crowd him too closely he turns over on his back and fights with his mouth and all four feet at the same time. Now is the time for the hunter to rush into the fray, shove his gun between the frantic dogs and get in a fatal shot.

BLACK BASS SHIPMENT TO MEXICO.

By GEORGE NEALE, Executive Officer, California Fish and Game Commission.

In 1909, at the request of the Mexican government, Mr. Chas. A. Vogelsang, at that time chief deputy of the California Fish and Game Commission, made arrangements for the shipment of black bass to Lake Chapala, Mexico.

The California Fish and Game Commission's distribution car No. 1, in charge of the writer, left Fresno early in December, 1909, with ninety-two cans containing about 1800 adult black bass. Some weighed as much as three pounds. After many delays, Ocotlan, on the shore of Lake Chapala in the Mexican state of Jalisco, was reached. Here the first planting was made. Seventy-two cans were transferred to lighters, which were towed by launches to the south end of the lake, where the fish were liberated. Some of them immediately began feeding on the minnows.

We were then taken to the governor's palace on the shore of Lake Chapala, and were lavishly entertained by Governor Landa. Accompanied by the governor's quartette of guitarists, we returned to Ocotlan after midnight in a terrific blow.

Lake Chapala is a magnificent body of water, larger but not so beautiful as our own Lake Tahoe. It contains a food fish known as the whitefish, which differs from our whitefish in that it is transparent. But it furnishes a fine food for the black bass, which food is most necessary to insure increase. Lake Chapala is also said to contain carp, but we did not see any. This lake should now (eleven years after the planting of these black bass) be an anglers' paradise for those who know how to lure the fish, which are, as Dr. Henshall states, "inch for inch, pound for pound, the gamiest fish that swims."

Our next stop was at a small lake a few miles north of Mexico City, in which we planted twenty cans of black bass. We accomplished all this with the loss of but two fish.

We were met at Mexico City and taken to dinner at the magnificent restaurant "Chapultepec," at the foot of the castle of the same name, which once was the home of Montezuma. We quartered at the St.



FIG. 55. Planting black bass in Lake Chapala, Mexico.

Francis Hotel, then a magnificent hostelry of the old Mexican type, and were royally entertained by the government. While there an amusing incident occurred, which illustrates the manner in which we were entertained. After signing the meal check, showing what we had received and the cost of the same, which was paid by the Mexican government, our interpreter came to us and said, "We observe there is no wine or liquor charged. Is it because you do not drink wines or liquors, or do we not have the kind you are used to drinking? If not, we will get the brands you care most for." We thanked him and

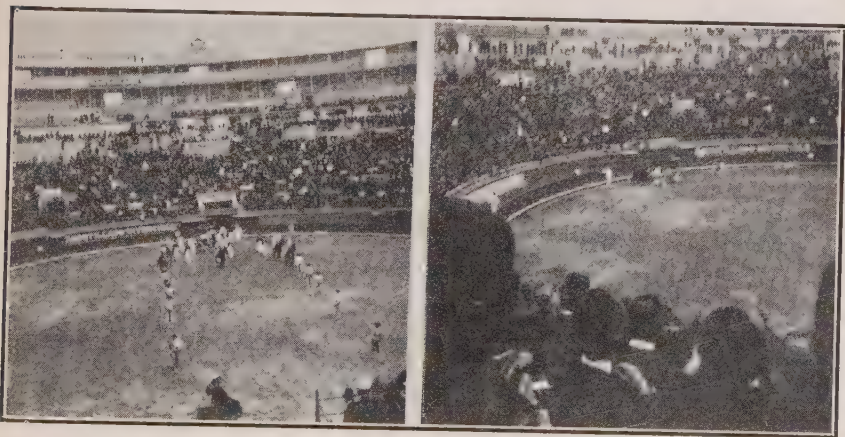


FIG. 56. Scenes at a bull fight at which employees of Fish and Game Commission were guests after conveying California black bass to Mexico City for planting.

assured him that nothing but our modesty had prevented us from ordering the most select wines.

Automobiles were placed at our disposal. The Christmas festivities were in full blast, and we had special seats for the opera, "The Merry Widow," also seats at the bull fight, which was attended by President Diaz and 48,000 people. We shall always wish to forget the bull fight. We were unable to leave the arena, so were compelled to witness some of the most shocking brutality and cruelty ever perpetrated. Thirteen magnificent bulls were slowly tortured to death. Eleven horses were gored and dragged out of the arena alive, their entrails protruding, amid the plaudits of 48,000 representative citizens. It is puzzling to know that people possessing such qualities of refinement and hospitality can witness such brutality.

Believing that it would be of interest to obtain information as to the success of the planting in Lake Chapala, the Mexican consul in San Francisco was appealed to, with the result that the following interesting reports were received:

(TRANSLATION.)

Government of the Free and Sovereign State of Jalisco.
Section Fourth, No. 16582.

To the Consul General of Mexico,

519 California Street, San Francisco, California.

Referring to your attentive communication dated October 31st last, by which you request information as to the success attained in acclimatizing in the Lake of Chapala the fish called black bass (lobina), I beg to inform you that I have, on my part, requested this information from the city mayors of the lake cities and their replies were the following:

Chapala Mayor's report:

"I have the honor to refer to your respectable communication issued by Section 4th dated on the 12th inst. and in reply to it I beg to inform you that in the Chapala Lake can be found the fish called BLACK BASS, in short number being more abundant toward la Cienega, La Palma and Jamau as I have been informed; in this place are caught very few of them due to the fact the fish named Carp (CARPA) fight them to death destroying either the fish itself or their spawn, being more destructive in the latter case which danger has not been possible to avoid on account of the latter named fish Carp is a courageous fighter against the other less warlike fishes as is the case with the WHITE FISH, BLACK BASS and other named CHARAL. This is, in my opinion, the cause that the fish in question is not more abundant, although I believe in its acclimatizing."

Jocotepec Mayor's reported on the 20th inst:

"Informed to my satisfaction from the most prominent fishers of the Lake of Chapala, in this region, I have the honor to say in response to your communication No. 9508, issued by Section 4th on the 12th instant that: on the shores of said Lake within the limits of this Municipality, they have not fished the BLACK BASS (Lobina) or Delicious fish that is known but it is believed it can be found in Jamay or in the emptying of the Rio Grande into the Lake."

Jamay Mayor's reported on the 29th inst. as follows:

"In reply to your communication No. 9509, issued by Section 4th on the 12th inst. I state that after the investigations made in order to find if the fish known by the name of LOBINA the fishermen of this place only informed me on the fishes they fish in this part of the Lake, viz: BAGRE in very short amount, the WHITE FISH very scarcely and that the fish named Carp is the more abundant."

Tuxcucca Mayor on the 20th inst reported:

"I beg to inform that respectable Government that in the region of Lake Chapala within the jurisdiction of this Municipality the fish known by the name of LOBINA has not been found and that I ignore whether this fish is to be found in any of the other Municipalities around the lake."

Tizapan Mayor, under the same date as the above, report as follows:

"I have the honor to inform you in accordance with the inquire contained in the communication of that Superiority under the number 15006, issued by Section 4th dated on the 15th inst. that on information collected from the fishermen within the jurisdiction of this Municipality is not known the fish named LOBINA mentioned in your said communication in any of the places where the fisheries are established."

Ocotlan Mayor under same date report:

"Relative to your attentive note No. 9510, issued by Section 4th dated the 12th of November ultimo in which you transcribe me the communication dated on the 21st of October last from the Consul General of Mexico in San Francisco, California, for the knowledge of the Governor of the State I have the honor to inform you that the fish known by the name BLACK BASS (Lobina), delicious fish, to which the preinserted note makes reference and known in all these places with the name of (LIZA) has been propagated relatively little in the Lake of Chapala and in a nearby place to El Fuerte, within the jurisdiction of this Municipality and in which place about 15 fifteen years ago approximately this fish was placed for its propagation but we have information that in the town of Poncitlan it is found frequently in the dam and in the river passing by that place."

Please to accept my attentive and distinguished consideration.

THE CONSTITUTIONAL GOVERNOR OF THE STATE.

Guadalajara, Jalisco, December 23, 1921.

The stated fact that black bass have not multiplied to any extent in the lake for the principal reason that carp have destroyed the spawn, is hardly plausible, for unless the Mexican species of carp is as aggressive and courageous as the Mexican bull, this is not the reason for the apparent lack of increase. Both the male and female black bass remain with the eggs in the nest until they are hatched, and both remain with the young fry afterwards. There is no American fish bold enough to attack a black bass or its eggs. In lakes where bass only abound, necessity compels the adult fish to devour its young, but Chapala has an ideal food in the whitefish. We have made many plantings of bass and have never seen a body of water having more of the requirements necessary to the successful introduction of these fish than Lake Chapala.

The black bass are the most difficult fish to catch with a net. They require certain lures to take them, such as live minnows, spinners, etc. In a body of water the size of Lake Chapala, containing all the natural feed, these fish are doubtless difficult to capture. In spite of the foregoing report, we feel positive they are present in large numbers and can be taken by those who know how.

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

APRIL 22, 1922.

"Of all sports, commend me to angling; it is the wisest, virtuouslest, best."—
Thomas Hood.

NEW EXECUTIVE OFFICER.

On March 14 Mr. Charles A. Vogelsang, who has been executive officer since 1920, resigned to accept another, more



George Neale, executive officer.

remunerative, position. Mr. George Neale, who has been in charge of the Sacramento district office since 1911, was appointed to succeed Mr. Vogelsang. Mr.

Neale comes to his position as one intimately acquainted with the fish and game of this state and the problems connected with its conservation. Every employee of the commission is extremely well pleased with the appointment, for they know that from the standpoint of knowledge, experience and personality, Mr. Neale is well equipped for his future work. It is fortunate, also, that the new position comes as a promotional appointment under civil service.

George Neale came to California when he was sixteen years of age, spending two years in San Francisco and then settling in Sacramento, where he entered the market produce business. Due to his interest in fish and game he was appointed game warden of Sacramento County in January, 1901, and two months later was appointed a deputy state fish and game commissioner. He proved himself a capable warden, cleaning up a particularly bad situation due to the laxity of enforcing the laws. On August 3, 1911, he was placed in charge of the Sacramento district office, which he has efficiently managed up to the present time.

Mr. Neale is an ardent angler and hunter and a true conservationist, and sportsmen and conservationists alike may look forward to an efficient administration of the fish and game resources of the state.

A HATCHERY NUMBER.

Perhaps the most outstanding achievements of the California Fish and Game Commission have been the successful introduction of numerous food and game fishes and the artificial propagation of trout and salmon for use in stocking barren streams and lakes and restocking depleted waters. Everybody knows from the local papers that sometime during the summer and fall the fish car makes an annual visit to some town close by and that thousands of trout fry are carried to nearby streams by interested sportsmen, but of methods and actual output from the hatcheries the average citizen knows little. How many hatcheries are there? What is the annual output? How are trout fry planted? These and many more questions are answered in this "Hatchery Number."

The Fish and Game Commission boasts of having retained the continuous services of a skilled fishculturist for thirty-nine years. Mr. Wm. H. Shebley, in charge of fishculture, whose picture is shown above, has the distinction of being the commission's oldest employee and of having been trained under such pioneer fish-

culturists as Livingston Stone and J.-G. Woodbury; Mr. Shebley, in consequence, knows California conditions and knows how to raise fish. The hatchery department has many employees who have



William H. Shebley, in charge fishculture.

"grown up" with the work. One of the employees, Mr. E. W. Hunt, field superintendent, has served the commission for thirty-five years; two others have served more than twenty-five years; four, more than fifteen years, and six for more than ten years. The efficiency of the department can be partly traced to the fact that the men engaged in fishcultural work are all experienced men.

INCREASING DEMAND FOR TROUT FRY EXHAUSTS HATCHERY RESOURCES.

Easy access to the streams and lakes afforded by the improved highways and the increasing use of automobiles, and the added thousands of people who are availing themselves of the opportunity to fish, are factors that have combined to make an ever-increasing demand on our hatcheries for fish for restocking. Each season sees a marked increase in the number of people who seek recreation in our mountainous districts, and the consequent drain on the trout in our lakes and streams has been very great, particularly during the past five years. To meet the

need, the department of fishculture has exhausted its resources. Every available dollar has been devoted to fishcultural work, and yet the demand increases.

Only a partial solution is possible as a result of the reduction of the bag limit from fifty to twenty-five. It may be that a shorter fishing season will have to follow in order that depleted streams and lakes may be afforded a chance to recover their former condition.

Every state in the Union where there is game fish to be found is confronted by the same problem. In most cases the condition is being met by an increased angling license to provide more funds for enlarging the output of the hatcheries. This is the remaining remedial measure left to California.

FREE FISHING FOR ALL.

For fifty years the Fish and Game Commission has been stocking the lakes and streams of the state with trout. That any of these stocked lakes and streams should become private property, with consequent restriction of fishing, would be an injustice. Several years ago the actions of certain riparian owners caused the commission to advocate the passage of a law providing that boards of supervisors could, if necessary, condemn a right of way along a stream for the use of fishermen. This law was passed. In recent years there have been many attempts by private individuals to close public fishing on certain lakes and sell fishing privileges for as much as \$10 a day. The one thing that has saved these lakes from becoming private preserves has been the fact that the state has annually stocked them, and consequently the fish do not belong to the riparian owners. Likewise, the importation of trout fry from other states has been discouraged, in order to prevent like developments. It seems reasonable that those who would make private gain from fish should utilize artificially constructed ponds, rather than publicly stocked waters. The commission positively refuses to stock with trout fry any waters of the state which are not previously declared in writing by the owners to be open to the general public for fishing purposes.

The Fish and Game Commission believes in championing the people's rights. This is substantiated by the attitude on proposals for making private fish preserves out of streams and lakes stocked by the state and by the action taken during the last legislature, when the attempt was made to place fish and game administration under a subsidiary division of the Department of Agriculture.

CONDITIONS SHOULD DETERMINE SPECIES OF TROUT PLANTED.

Many of the applicants for trout fry specify a preference for rainbow. There is no doubt but that the rainbow is the gamiest of the trout, and usually superior for food, also; but it must be remembered that some of the introduced species do better than our native trout in some localities. The eastern brook trout, although a failure in coast streams, thrives in the slow-moving, meandering stream of a mountain meadow, whereas the rainbow is at his best in the rushing, boulder-strewn stream of the granite-walled canyons. Furthermore, it has been found that the brown trout thrives in certain streams where attempts to furnish good fishing by planting rainbow failed. The Loch Leven makes a splendid stream and lake fish and grows to large size. The steelhead, which furnishes a better supply of eggs than the rainbow, makes a suitable substitute for the rainbow in most situations. Were a sufficient and economical supply of rainbow eggs available, the commission would be pleased to supply the constant demand for this species, but the securing of a larger supply than is now obtained is difficult and expensive as well. The fishcultural department is in a position to know what species will thrive best in the different localities, and it attempts to allocate the fry accordingly.

THE PLANTING OF FRY.

The Fish and Game Commission is constantly receiving requests from all parts of the state for assistance and cooperation in planting trout and other fry in the waters of the state. It has been and is becoming more and more impossible for the commission to bear the additional expense of planting fry, as increasing demands necessitate the use of all funds available for the propagation and rearing of the fry to the planting stage. The expense of distribution has for many years been cheerfully borne by anglers' associations and individuals most interested. That this method of planting continue seems the more reasonable, because of the increased cost of transportation and because of the personal interest developed. During the war all free transportation of fish and employees engaged in fish planting was cancelled by the railroads, and the former privileges have never been restored. The commission now pays full transportation for the two fish cars and employees, and the annual bill amounts to thousands of dollars. From the standpoint of conservation the

present method is desirable, for the reason that individuals or associations cooperate with the commission in planting fish and assume an interest in the plant made, and good publicity results from the cooperation. Apparently, neither anglers' associations nor individuals have found their share of the work a burden.

ELECTRIC FISH SCREEN.

Several articles have appeared in recent periodicals relative to the perfection of an effective screen utilizing an electric current for use in irrigation ditches. These articles are altogether too optimistic, in the light of investigations made by the California Fish and Game Commission. On several different occasions the apparatus has been given a thorough test and found unsatisfactory. Young fish, placed in a ditch for experimental purposes, readily ran between the electrodes when the current was not too strong, and were quickly killed by the current as soon as a certain voltage was obtained. Considerable time and money have been expended by the commission in an endeavor to test and see whether electricity could be used advantageously as a means of screening fish from irrigation ditches. But up to the present time no one has satisfactorily demonstrated that this principle is practical when trout and salmon are to be prevented from passing into large ditches or canals. Further experiments will be made this coming season on an improved method of using the electrodes.

MANY SPECIES OF TROUT SUCCESSFULLY REARED.

The species of trout which have been successfully reared at state hatcheries follow:

NATIVE.

McCloud River rainbow	.....	<i>Salmo shasta</i>
Rainbow	.....	<i>Salmo irideus</i>
Cut-throat	.....	<i>Salmo clarkii</i>
Steelhead	.....	<i>Salmo gairdneri</i>
Black-spotted	.....	<i>Salmo henshawi</i>
Large lake	.....	<i>Salmo tahoensis</i>
Golden	.....	<i>Salmo roosevelti</i>

INTRODUCED.

Eastern brook	.....	<i>Salvelinus fontinalis</i>
German brown	.....	<i>Salmo fario</i>
Loch Leven	.....	<i>Salmo trutta levenensis</i>
Mackinaw	.....	<i>Cristovomer namaycush</i>
Landlocked salmon	.....	<i>Salmo salar sebago</i>
Grayling	.....	<i>Thymallus montanus</i>

Experimental hatching of several other food fishes has been undertaken at vari-

ous times. Included were the whitefish, striped bass, shad, muskallunge and Japanese ayu.

FISH TRANSPORTATION.

At first, transportation of fish to the stream was accomplished with horse and wagon, or by direct express shipments or in baggage cars. At the 1909 session of the legislature \$7500 was appropriated for a fish car and equipment. The car, 60 feet long, was built in the shops of the Southern Pacific Company at Sacramento and is still in use. It is fitted up with an engine-room in which is located a boiler for generating steam to run two Westinghouse air-pumps, used for forcing a circulation of air through a series of pipes and tubes into the 125 cans that the car is equipped to carry; also a refrigerator, tanks for carrying a supply of fresh water, berths for the attendants, a culinary department, an office for the superintendent of the car, besides lockers for the tools and equipment required in carrying the fish. This car has enabled the commission to carry thousands of fish in perfect condition all over the state, at a saving in the cost of transportation amounting to hundreds of dollars each season. Formerly it required two men to care for 12 or 15 cans; in the special car four men can care for a load of from 100 to 125 cans, carrying from 200,000 to 400,000 fish. Since the car has been in operation, three times as many fish as before have been distributed during the same period of time. Furthermore, the fish carry better and are delivered in better condition. A second fish car was put in operation in 1915.

In recent years the motor truck has played an important part in transportation. The Mount Whitney Hatchery is equipped with two large trucks. There is a one-and-a-half ton truck in use at the Mount Shasta Hatchery; the distribution of fish from the Feather River Hatchery is handled with a two-ton truck and each of the other important hatcheries has a Ford truck as part of the equipment.

From the nearest railway station the fish are carried to the mountain stream either by truck or by pack train. Special pack-cans are utilized with animals, and the fish stand long journeys without injury.

TROUT FOOD INTRODUCED.

It seems reasonable to believe that an increased food supply for trout in certain streams might increase the supply and better the fishing. The commission has

consequently experimented in the transplantation of certain insects and crustaceans notable as food for trout. As early as 1897 crawfish and salmon flies were introduced into the Truckee basin. In more recent years salmon flies have been introduced and now thrive along many streams in the Tahoe region.

IN MEMORIAM.

George McCloud departed this life October 19, 1921. He was born near Gazelle, Siskiyou County, June 24, 1863. The son of Ross A. McCloud, one of the pioneers of Siskiyou County, who at one time was county surveyor, George McCloud spent his childhood at Upper Soda Springs and at Yreka.

He was educated in the common schools of the county and in Ashland Academy. After leaving school he was employed on the survey of the Southern Pacific Railroad under Chief Engineer William Hood, when that road was being surveyed and built through the Sacramento Canyon and over the Siskiyou Mountains.

In 1886 he came into possession of a half interest in the Upper Soda Springs resort, and with his sister, Mrs. Elda Massen, operated this popular resort for a number of years. During this period he established a resort on McCloud River, that was named after his father. The best information that the writer can obtain regarding the origin of the name of McCloud River, is that it was named after Mr. McCloud's father, Ross A. McCloud. This statement has been disputed by some, who claim that the river was named after a man named McLeod, who was in the employ of the Hudsons Bay Company as a trapper, but there is not any doubt in the minds of the first settlers that the McCloud River was named after Ross A. McCloud, who came to Siskiyou County in the early fifties and prospected on the river that was given his name by early settlers. George McCloud sold his McCloud River property in 1890 to Clarence Waterhouse, who employed him as his fiduciary agent in charge of his property on the McCloud River, as well as on a mining venture in Alaska.

George McCloud was a thorough sportsman and enjoyed the esteem of the best sportsmen in California. His knowledge of wild life, particularly the fishes of Northern California, gave him an enviable reputation, and his services were often sought by those who desired to enjoy an outing where good fishing could be had.

In 1911 he entered the employ of the California Fish and Game Commission.

His knowledge of the trout and salmon was of great value to him in his new position, and he made rapid progress in his work. He was employed as fishculturist in charge of an egg-collecting station, and superintendent of one of the commission's distribution cars, until his illness early in the summer of 1921 caused him to retire.

Mr. McCloud's death is deplored by a host of friends. He was an honest, upright and concientious man. In his pass-

lots of rainbow trout eggs to the Hawaiian Islands: 50,000 in the spring of 1919 and 25,000 in the spring of 1920. The executive officer of the Fish and Game Commission of the Territory of Hawaii, under date of December 20, 1921, reported as follows: "In the streams visited on Kauai which had been stocked, dozens of rainbow trout were seen in every pool. I have never seen more fish in virgin streams in the Cascade Moun-



George McCloud, pioneer of Siskiyou County, for many years a trusted employee of the Fish and Game Commission.

ing the Fish and Game Commission lost an efficient and dependable employee.

There survive to mourn his loss his wife, Mrs. Mary McCloud; two sons, Ross A. McCloud, who succeeded his father as superintendent of distribution car No. 2, and George McCloud Jr., superintendent of Mount Whitney Hatchery; two daughters, Mrs. Carrie Hickman and Mrs. Ruth Wheeler, and a sister, Mrs. Elda Massen.

RAINBOW TROUT THRIVE IN HAWAIIAN ISLANDS.

Within the past few years the United States Bureau of Fisheries has sent two

lots of rainbow trout eggs to the Hawaiian Islands: 50,000 in the spring of 1919 and 25,000 in the spring of 1920. The executive officer of the Fish and Game Commission of the Territory of Hawaii, under date of December 20, 1921, reported as follows: "In the streams visited on Kauai which had been stocked, dozens of rainbow trout were seen in every pool. I have never seen more fish in virgin streams in the Cascade Moun-

MANY LIONS SECURED IN GAME REFUGES.

Since the beginning of operations by the state lion hunter, 47 mountain lions have been killed in and around game refuges and 20 others in and around national parks. Eight lions have been killed in Fish and Game District 2A, five in Fish and Game District 3C, one in

Fish and Game District 3B, twelve in Fish and Game District 1E, and twenty-one in Fish and Game District 1I, on the three different trips into this refuge. Eight lions have been killed in and around Sequoia National Park and twelve in and around Yosemite.

COMMISSION FEEDS DEER AND QUAIL.

During February of this year the extreme cold weather caused much suffering among the wild birds and animals, especially among the quail and deer, in the higher altitudes of the state. Realizing the need for action in the matter, President Newbert of the Fish and Game Commission circulated through the newspapers the following letter:

"This is the time that tells the tale whether a man is just a meat hunter or a real red-blooded sportsman. It may be that many wild birds and animals are isolated in areas where it is impossible for our wardens to find them, owing to the deep snow. Nature teaches all wild life when in need to seek man and civilization.

"Therefore, residents of farms or towns are in a position to render aid by feeding these wild birds and animals. Our commission is more than willing to purchase feed to tide over these storms, and will authorize the expenditure of funds by our wardens.

"We ask all lovers of wild life to feed, temporarily at least, birds and animals until such time as our local deputy or district office may be notified."

The enthusiastic response to this letter, not only from the deputies and forest rangers but from many of the residents who fed numbers of birds and animals gratis, was very gratifying. In Plumas County about 150 head of deer were saved from starvation. In Siskiyou County several large flocks of quail were fed, one flock numbering 250. Fortunately no great loss has been reported, though the quail above the 2000-foot altitude were without feed for four days.

In Lassen County, deputies fed large numbers of quail and pheasants every day, as well as deer and antelope. The grain and hay used was furnished gratis by the people of the section. In Grass Valley the estimated number of quail cared for was 2500, and the number of deer about 400. Twelve hundred pounds of hay and 237 pounds of grain were fed at Indian Valley alone, the work requiring the assistance of several men, with teams, pack horses and mules.

REDDING DAM DISPUTE SETTLED.

The controversy regarding the installation of a fish ladder on the dam of the Anderson-Cottonwood Irrigation District at Redding has at last been settled. An injunction suit was brought by the commission against the irrigation district, and the case came up for trial on January 30, 1922, before Judge Herzniger of Redding.

The commission fully demonstrated that a suitable fishway had not been erected and that as a direct result thousands of salmon have found it impossible to reach their spawning grounds. But in order not to be too implacable in its attitude toward the irrigation district, which is already in financial troubles, the commission finally, on the fourth day of the trial, agreed to a settlement. The following agreement was signed by officials of the Anderson-Cottonwood Irrigation District and by the executive officer of the California Fish and Game Commission:

"The board of directors of the Anderson-Cottonwood Irrigation District and the people of the State of California, represented by the Board of State Fish and Game Commissioners, will cooperate, with and by the advice of the engineers of said district and the engineer of the State Fish and Game Commission, to use present facilities offered by the dam of said district for the purpose of passing salmon over said dam, to the end that the flow of water in the canal of said district shall not be impaired and the migration of salmon shall not be obstructed, and to that end the following recommendation is made:

1. Insert flash boards in the present fishway to check flow of water through the 12-foot space and from a pool below.

2. If this proves inadequate, insert flash board in vertical plane to perfect fishway.

3. If this proves inadequate, sink a timber box, 12 feet square, above the dam at the fishway to form an additional pool.

If it is found that said plan does not operate as a fishway for the free passage of salmon, then, and in that event, said district agrees to make such improvements on said dam as will adequately facilitate the passage of salmon over said dam, this being the intent and purpose of this agreement, and if any additional facilities for the passing of salmon over said dam are found necessary, should the proposed scheme prove inadequate for passing salmon over said dam, any further improvements made necessary shall be made with due regard to economy as well as to the other purposes to be accomplished herein.

(Signed) Anderson-Cottonwood Irrigation District; David Nelson, director; Charles H. Spann, director; W. F. Smith,

director; Andrew Jessen, director; California Fish and Game Commission, Charles A. Vogelsang, chief executive officer."

As a result of the above agreement, a dismissal of the case was ordered by the superior court. Thus was ended one of the bitterest fights having to do with the conservation of salmon and the enforcement of the law relating to fishways.

MOUNT DOME ANTELOPE HERD.

The largest herd of antelope remaining in California makes its home at the south end of lower Klamath Lake, near Mount Dome. A recent census has shown that

COLD WEATHER KILLS PISMO CLAMS.

Subtropical fruits and vegetables are not the only things which may be killed or injured by cold weather in California. It has been reported to the State Fish and Game Commission by its deputy H. D. Becker that the recent cold snap has resulted in the killing of great numbers of Pismo clams, which in this instance may be compared with subtropical fruit, for they are a southern form and in San Luis Obispo County, where freezing was most noticeable, are near the northern limit of their range. Some clams, like the eastern soft shell which remains stationary in its hole



Fig 57. Antelope on the proposed Mount Dome Antelope Refuge. Photograph taken January 15, 1922, by J. O. Miller. About 40 antelope show in the picture.

about 100 of these animals are to be found in this region. Because of the past hard winter these antelope were in need of additional food. The big game committee of the California Academy of Sciences, headed by Mr. M. Hall McAllister, became interested and furnished funds for the winter feeding of the herd. The accompanying photograph (Fig. 57) shows forty of the eighty-seven animals which came in to feed. The California Fish and Game Commission, the United States Forest Service, the California Academy of Sciences and other organizations are cooperating to give these antelope a maximum of protection. Several men have been deputized to watch for poachers and to see that the animals are properly cared for, and a move is now on foot to have a large area set aside as a permanent refuge for these antelope.

in the mud, may be frozen almost solid and be no worse for the experience after thawing out, but it is not so with the Pismo clam.

Through investigations made for the Fish and Game Commission by Professor F. W. Weymouth of Stanford University, much has been learned of the growth and habits of this interesting and most important of California's clams. The young Pismo clams spend the first three years of their existence above the low-tide line, on gently sloping, sandy beaches. They are very active creatures and can bury themselves rapidly in the sand by means of their tongue-like "foot." And it is necessary that they be active, for the sand is continually moving in the surf, and in the wash of the waves during the flow of the tides up and down the beach they

would be washed out and cast high on the beach if they did not dig rapidly.

During the recent cold spell these clams of tender age, being the young crop of the last three years and with shells not exceeding three inches in diameter, were so chilled or frozen during the few hours they were left exposed in the wet sand while the tide was out that they were unable to dig in with the flow of the tide, and were ignominiously cast high on the beach, where, with muscles too near frozen to keep their shells from gaping, they fell easy prey to the gulls and pelicans, which came from far and wide to the feast.

The damage to the young crop of clams has been very great. But, serious as is this loss, it is not nearly so serious as the destruction to these immature clams caused by summer visitors to our beaches digging them for food and sport in violation of the law, which prohibits their capture until they have developed shells $4\frac{3}{4}$ inches in diameter. It is unfortunate that the best beaches for Pismo clams are also our best pleasure beaches, where the people congregate in great numbers each summer. It is natural to dig in the sand, and if there is a prize to dig for, even if it be a very small clam, it seems to add fascination, and the chance of being caught by a game warden appears to lend excitement to the sport. Only once in the memory of the oldest inhabitant has extreme weather killed the young clams, but destruction of the young crop always exposed to thoughtless pleasure seekers takes place every year, and is far more serious.

The Fish and Game Commission has been warned by Professor Weymouth that destruction to the young crop of clams in violation of the law is more serious by far than the recent destruction by cold weather, or even the operations of professional clam diggers, at whom the local clam conservationists have been pointing their fingers. The matter is so serious that even the prohibiting of professional digging and the sale of clams may not save the Pismo clam from becoming extinct in California, unless the public learns the importance of protecting the undersized clams. Legal-sized clams can be found at extreme low tide, or, if one wishes really exciting sport, let him go into the surf after them with a clamming fork.

FISHERIES CONFERENCE MEETS AT SAN PEDRO.

In January the scientific staff of the California State Fisheries Laboratory at San Pedro held a conference to discuss

the program which is designed to properly care for the fisheries of the State of California, particularly the great sardine fishery which has arisen within the last five years and which in 1919 produced 154,000,000 pounds of food fish.

So recent has been the origin of this great fishery that nothing is yet known about the permanence of its supply of fish. Fishes of the group to which the sardine belong show great fluctuations in abundance, at times being so scarce as to greatly limit the fishery for them, at others being in enormous abundance. The scientists of the State Fisheries Laboratory have planned their work to provide information concerning the possibility of such great and disastrous changes, which will be studied according to the most recent methods developed in Europe by the International Council for the Investigation of the Sea, and by Norway.

The program devised will also bring out the possibilities of depleting the fisheries by imposing too great a strain. It is not yet known whether the fisheries on the Pacific Coast are able to stand such strains as have been placed upon the Atlantic species of fish, but it is surmised that they can not. The sardine, as do other fishes, depends upon the food produced by waters near the shore, where certain natural elements necessary to the growth of their food are present. Along our coast this coastal water supply is decidedly limited compared to that found along the coasts of northern Europe, where the greatest fisheries have been carried on. It will be necessary, therefore, for the California Fish and Game Commission to exercise special vigilance to see that the supply is not exhausted by reckless use, such as the use of sardines for fertilizer in unlimited quantities. The observation of the supply is a matter for careful scientific observation by biologists, along lines similar to those indicated by the men in session at the laboratory.

But it has been necessary for the commission to do more than provide such a program of work, for it has become obvious that men specially trained for its execution are necessary. Since such men are not obtainable at the universities, the State Fisheries Laboratory has undertaken the training of students, who are later expected to finish college, where they are granted sufficient work and payment therefor to constitute a scholarship. The conference dealt with these matters, as well as the program of work.

This conference was held in the splendid new building recently completed for the scientific workers at San Pedro.

MARKET HUNTERS FIND WATCHFUL WARDENS.

The sale of ducks is now largely a thing of the past. Where the San Francisco markets formerly had 300,000 ducks, the illegal sale at present must be but a few hundred, or at most a few thousand birds. Of course, in spite of the federal law prohibiting the sale of ducks, the incentive of the dollar drives a number of men to continue each winter their former trade of market hunting. Automobiles and good roads make it possible for the duck bootlegger to continue to operate. But quick convictions and heavy fines have been meted out the past season, and the

FAULT FOUND WITH THE PUBLIC SHOOTING GROUNDS BILL.

The New-Anthony bill providing for a federal license to hunt migratory birds and for the establishment of public shooting grounds and game refuges, which has been widely endorsed by sportsmen's organizations and game commissions, was not all that it was made to appear to be in the publicity given it. By a provision almost hidden in the text there is unwarranted encroachment by the federal government on the rights of states. Section 13 provides for complete control of every "fish, wild animal, or wild bird,"



Fig. 58. Ducks seized near Willows on December 14, 1921, after night-shooters had abandoned their kill at the approach of Fish and Game Wardens.

man who hunts for the market has to turn outlaw and smuggler.

The accompanying picture (Fig. 58) shows the destruction due to this type of hunting. Deputies of the commission heard night shooting near Willows on December 14, 1921, and investigated. The hunters ran, leaving a hat and "long gun" (an automatic capable of firing ten shots) and hundreds of ducks on the ground. After the birds had been collected, the photograph was taken.

Information withheld by residents of the duck country sometimes makes it difficult to make arrests. Deputies spend night after night in the cold, wet marshes, doing their utmost to stop market hunting, and yet those who could be most helpful in furnishing information refuse to aid. Proper information is often the most important part of gaining an arrest and conviction.

whether it be resident or migratory. Judging by court decisions, this is unconstitutional. Furthermore, the bill provides for administration by a commission composed of the Secretary of Agriculture as chairman, the Attorney General, the Postmaster General and two members from each house in Congress. How are the sportsmen represented on such a committee? Worse, the commission is purely political and has the power to spend millions of the sportsmen's money. Any law of this kind should be administered by a commission made up of conservation experts.

It was the fish and game commissioners of the Western states that discovered the flaws in the bill and made the first important protest. A convention was held at Salt Lake City and the following resolutions were passed:

A RESOLUTION

Adopted by the Western Association of
State Game Commissioners
January 17, 1922.

The several commissioners and game wardens of the game and fish departments of the states of Arizona, Colorado, Montana, New Mexico, Oregon, Utah and Wyoming, in conference assembled at Salt Lake City, Utah, this seventeenth day of January, 1922, having carefully considered United States Senate Bill No. 1452, entitled "The Federal Public Shooting Ground and Game Refuge Act," do unanimously adopt the following resolutions:

WHEREAS, We appreciate the need for the establishment of public shooting grounds and game refuges in various parts of the United States, for the benefit of the public at large and for the protection of migratory birds; and

WHEREAS, We, through our several game and fish departments in the states which we represent, have given our full support and cooperation to the efforts of the federal government to successfully administer the present federal migratory bird laws and regulations; and

WHEREAS, We approve of the purpose and aims of the federal government as evidenced by the present migratory bird laws and are in favor of such additional legislation as may further such purpose; and

WHEREAS, On the other hand, we are not unmindful of the inherent sovereignty of the several states as recognized in the decision of the Supreme Court of the United States in its determination that the game and fish within the confines of each state are the property of such state and, therefore, under the jurisdiction and control of state authority; and

WHEREAS, We disapprove of the centralization of control in the federal government, of the game birds, animals and fishes which find their range within the confines of any state; and

WHEREAS, The purport of said Senate Bill No. 1452 is not, in our opinion, as indicated in its title, but, on the contrary, is designed to, and will result in, an unwarranted encroachment by the federal government upon the rights of the various states in the protection of their fish and game, and in the administration of their fish and game laws; now, therefore, be it

Resolved, That we protest against the enactment into law of United States Senate Bill No. 1452 for the reasons as set forth in the foregoing preambles and more specifically because:

1. Said Senate bill, although in its title "providing for establishing shooting grounds for the public; for establishing game refuges and breeding grounds; for protecting migratory birds and requiring a federal license to hunt them," nevertheless, in the body thereof, purports to give authority in nowise indicated in the title, and delegates power to the Department of Agriculture and a committee consisting of the Secretary of Agriculture, the Attorney General, the Postmaster General, two members of the Senate and two members of the House of Representatives, giving said commission complete legislative powers to make rules and regulations which will have the force of laws governing and controlling, not only the migra-

tory birds and the game animals, but also the fishes that may be found in their natural state or introduced into any of the lands or waters upon any game preserve secured under said act, either by gift, lease or purchase.

2. We do not approve of creating a federal organization of game wardens which, in the enforcement of said act, will largely duplicate the work of the state organizations for the protection of fish and game, thereby increasing the operating expenses necessary to the enforcement of the law, and tending to create conflicting authority between state and federal game wardens and to disrupt the harmony and unity of purpose now existing between the state and federal departments.

3. We object to the federal government assessing a license fee against citizens of a state for the privilege of hunting and fishing within the confines of his own state.

AND WHEREAS, We believe that the enforcement of the migratory bird law is of sufficient importance to justify a direct appropriation from Congress for that purpose; be it further

Resolved, That we favor a direct appropriation from Congress for the purpose of enforcing the Migratory Bird Treaty Act and the establishment of public shooting grounds and game refuges under the direction of the Biological Survey.

It has been determined to express the foregoing ideas in resolution form for the purpose of conveying to the Congress of the United States a concrete expression by the fish and game officials of the above named states who are primarily interested in legislation, be it state or federal, which will be most suitably designed to accomplish the protection and increase of the fish and game of the country and to avoid submerging a laudable common purpose, in disputes and conflicts (intensified possibly by a sense of unjust assumption of federal control) between officials and employees of departments of government with overlapping coordinate authority.

J. W. TINGEY,
Secretary.

D. H. MADSEN,
President.

The original bill thus exposed should have no chance of passing, but strange things happen, and if sportsmen and conservationists remain apathetic, states will be robbed of their rights and sportsmen's license money exploited by a political commission. The California Fish and Game Commission has now refused to support the bill unless it is suitably amended, and California representatives in Congress have been so informed.

DEER HUNTERS SHOOT CATTLE.

In our January issue a long list of hunting accidents furnished evidence that many hunters are careless when in the field and fail to "look before they shoot." Now comes additional evidence of like carelessness in a report of the United States Forest Service, which states that

on eight of the national forests of this state sixty-four cattle and three horses met death from hunters' bullets during the last open season. And this killing of animals is but one of the just complaints of the cattleman. Some hunters, neglectful of others' interests, break down fences and leave gates open. Furthermore, in late summer, campers often usurp the only watering place for miles around and continually drive the cattle away, to finally die for lack of water. Unless hunters take some steps to correct these evils themselves, it is certain that the men financially concerned will be instrumental in further curtailing the hunter, and the careful will be made to suffer with the careless.

EDUCATIONAL WORK IN YOSEMITE TO CONTINUE.

At the request of the National Park Service, the Fish and Game Commission will again cooperate in educational work in the Yosemite National Park this coming summer. As in past years, the incidental expenses and the expense of assistants will be assumed by the National Park Service. Last year over 31,000 persons received instructions through the medium of lectures, and over 2000 persons were taken afield and given first-hand information regarding wild life.

The California Nature Study League, which has been greatly interested in the project, recently sent the following letter to President Newbert:

MR. FRANK NEWBERT,
President California Fish and Game Commission,
Sacramento, California.

MY DEAR MR. NEWBERT:

On behalf of the California Nature Study League, may I thank you for the Fish and Game Commission's continued conduct of the educational work at Yosemite National Park? There is probably no money expended by the State of California that will eventually bring bigger dividends to the taxpayers than such educational work.

The last time I was leaving Yosemite I happened to meet on the train a group of people from San Mateo County. One of the children, a girl of about eleven, had been tested in the mental tests at Stanford University. She ranked so high that the professor declared she was about one in a million. In other words, there were only about 110 people in the United States, adults and children, as bright as this girl. In other words, she will be a

genius of the tomorrow. She had had training along other lines, as literature and art, but her first stimulus to scientific education was through the work of Dr. Bryant of your staff.

Just what may come of this you and I will probably never know. We will probably both be old men if we even live to see the fruiting of that intellect. Does it not show dramatically, however, the tremendous possibilities of the wild-life conservation work which your commission is doing?

Sincerely,
(Signed) C. M. GOETHE, President.
California Nature Study League.

STANFORD PLANS ANIMAL REFUGE.

If the plans of the Zoological Club at Stanford University are successful the 800 acres comprising the Stanford Farm will become a state game refuge. The Zoological Club has offered to furnish the labor necessary for making and posting signs and to render all possible aid in detecting and reporting violators of the refuge. Illegal hunting and wanton killing by people from off the campus has stimulated this move to carefully conserve all the animal life of the university holdings.

BIG GAME IN SWEDEN.

Moose are to be found in many of the central and northern provinces of Sweden and are being conserved and protected in spite of open hunting grounds and the absence of artificial game regulations which are so common in other European countries. The open season is two weeks in September, and each permittee is allowed to take one cow and one bull. There is no general license system; the hunter may procure a license from the state for hunting on state lands, or, if hunting on private lands, a permit may sometimes be obtained from the owner; in either case the cost of the license is much greater than the cost of the American license.

The following table shows the number of moose killed in different parts of Sweden during the year 1919, as reported by forest supervisors and rangers of the Swedish Forest Service:

Number Killed During the Two Weeks Open Season.

Bulls	791
Cows	580
Calves	7
Sex not given	31
Total	1509

*Number Killed During
Closed Season.*

Bulls -----	22
Cows -----	12
Calves -----	4
Sex not given -----	80
Total -----	118

Total killed during year ----- 1627

(From Sveriges officiella statistick Utdrag ur revirbersattcheruas uppgifter.)

In general, the reports show that the moose are decreasing, due to excessive



FIG. 59. Rainbow trout caught on San Joaquin River and photographed by A. A. Rohde.

hunting during the years of crisis. A closed season for several years is contemplated.—G. W. HULT, San Francisco, California.

**A PHOTOGRAPH OF A RAINBOW
TROUT.**

Since clear, detailed photographs of fish are often difficult to obtain, we are publishing herewith a successful picture of a rainbow trout secured by Mr. A. A. Rohde of Fresno, California, taken near Bass Lake, Madera County, on the San Joaquin River (Fig. 59). Mr. Rohde took this picture with the fish two feet from the camera, using a Ray color filter over the lens and a 5 by 7 plate. The trout weighed 3 pounds and was 8 inches in length.

**DANGER TO FISHERIES FROM OIL
AND TAR POLLUTION OF WATERS.**

In the report of the United States Commissioner of Fisheries for 1921, Mr. J. S. Gutsell discusses at some length the danger to fisheries from oil and tar pollution of waters. He points out that three main sources of oil and tar pollution have been found: Road washings, carrying great quantities of lubricating oil; gas houses and oil refineries; tankers, oil burners and oil-engined shipping. Tars, tar oils and crude distillery products are found generally to be highly poisonous, whether in weak or great dilution. Some oils have been found to emulsify to a sufficient degree, with continued agitation, to coat the gills of fish and so produce death by suffocation. An oil film, through prevention or checking of aeration, is dangerous, particularly in busy harbors. The deleterious effect on spawning, by rendering spawning grounds unfit or inaccessible, is a grave danger arising from the pollution of harbors and streams. Another serious danger is found to lie in the possible effects on the diminution of the food supply. Through whatever means, it is an observed fact, according to Weigelt, that in Germany fish have completely disappeared from pools and ponds following the discharge of mineral oils into the water. In the sea a great danger is suggested by the fact that the eggs of sea fishes are typically floating, and that oil-burning and oil-engined shipping is greatly increasing.

Remedial measures may (now or in the future) be found: (1) In the recovery of oils from drainage water, as already has been proposed; (2) in the prevention of gas-house and refinery pollution, which prevention should be helped by the increased use of "wastes" in by-products;

and (3) in prevention, by international arrangements, of the dumping of oil from ships in harbors or in the region of spawning grounds or special feeding areas.

FISH COOKERY.

"The last word on fish cookery" has just been given to the public by Messrs. Little, Brown & Company of Boston, in a volume on "Fish Cookery" by Evelene Spencer and John N. Cobb. Mrs. Spencer, after spending much time demonstrating fish cookery in the city of Portland, Oregon, in connection with its municipal fish market, was engaged by the government during the "Eat More Fish" campaign, to travel through the country, explaining the food value of fish and the desirability of using the less familiar species, illustrating her lectures by various methods of cooking this food.

Mr. Cobb, the co-author, is director of the College of Fisheries, University of Washington, Seattle, and the author of numerous works on the fisheries. He has contributed valuable information as to the fish themselves, and tables as to their food value, their location, seasons, etc.

The book contains more than 600 recipes for cooking fish and its accompanying sauces and dressings. Every conceivable manner of serving fish is described, treating not only the subject of the common and well known varieties, but numerous

little-known and seldom used varieties as well, which contain equally valuable food properties. This last word on fish cookery should serve to bring that little appreciated branch of the art into its proper place in the preparation of a well-balanced menu.

UNITED STATES TOPOGRAPHIC MAPS.

Every hunter and fisherman who goes to the mountains should carry with him a United States topographic map. From these maps he may obtain information relative to streams, lakes, springs, elevations, and even cabins and other civilized institutions. There are few states where so much use is made of unsettled districts as in our state, and it is quite important that all areas open to the summer vacationist should be properly mapped. At the present time one may secure suitable topographic maps of almost any area on the desert and in the Sierra, and one may travel from the Mexican line as far north as Point Reyes utilizing a government map. The area to the north of Point Reyes, however, is still unmapped, although much used as a recreation ground. A little pressure brought to bear on the United States Geological Survey would assure the completion of the series of maps now available.

FACTS OF CURRENT INTEREST.

The California fisheries production for 1921 was 123,192,193 pounds of fish and 5,310,251 pounds of shellfish, making a total of 128,502,444 pounds. The total production for 1920 was 213,847,825 pounds.



With the increased rainfall the past year has come a splendid run of steelhead trout in the coastal streams.



The 1921 sardine catch was 59,332,305 pounds, which was only one-half as large as the 1920 catch.



The principal decrease in the fish catch noted in 1921 was of varieties used for packing purposes. Of the 128,502,444 pounds of fish and mollusks taken in California during 1921, approximately 66 per cent was used for canning and packing purposes, 30 per cent was used in a fresh state, and the remaining 4 per cent consisted of mollusks and crustaceans.



The salmon catch in California in 1919 was 13,145,727 pounds; in 1920, 11,133,819 pounds, and in 1921 it was only 7,990,932 pounds. A decreased catch is shown in all the salmon-fishing districts of the state.



Severe weather during February necessitated the feeding of quail and deer in many sections to prevent their starvation.



Spawning operations for the past season have been fairly successful considering the severe weather. A good take of eggs is assured.



Computation shows that the California Fish and Game Commission has planted more than 1,128,800,000 fish in the streams and lakes of this state.

COMMERCIAL FISHERY NOTES.

N. B. SCOFIELD, Editor.

CHICAGO, MINNEAPOLIS AND ST. PAUL AS FRESH FISH MARKETS.

The United States Bureau of Fisheries has just issued an economic circular entitled "Trade in Fresh and Frozen Fishery Products and Related Marketing Considerations in Chicago, Illinois," and another with a similar title but for the twin cities, Minneapolis and St. Paul. These circulars are by L. F. Hopkinson, agent of the bureau. The reports are quite complete and of great interest to all who may be interested in the marketing of fresh and frozen fish.

Chicago gets its fresh fish supply principally from Canada, the Great Lakes and the north Pacific Coast. A million and a quarter pounds of ciscoes, chubs and yellow perch were landed by Chicago commercial fishermen fishing in Lake Michigan during the last fiscal year. With the exception of halibut and salmon from the Pacific Coast and shucked oysters from the Atlantic Coast, the consumers prefer fresh water varieties. Seventy per cent of the fish trade is confined to eleven species, as follows: Buffalo-fish, carp, ciscoes, halibut, lake trout, pike or "jacks," salmon, whitefish, yellow-perch, yellow-pike and shucked oysters.

It is interesting to note that the two principal varieties consumed are the carp and a fish closely related to it, the buffalo-fish. The buffalo-fish come from Minnesota, Illinois River, Mississippi River and other nearby rivers, and are shipped to market "in the round" in 100- to 150-pound boxes and in barrels of 200 pounds each. The carp come from the same source and from the Great Lakes. They are shipped both "in the round" and dressed, in boxes and barrels. Shad are popular during season, but the supply, coming from Baltimore, Md., New York, N. Y., Florida and California, is limited.

Fish arrive in Chicago mostly in car-load lots, both fresh and frozen. During the year ending July 31, 1921, a total of 526 carloads was received from Canada, as against 272 from the United States. During the same year a total of 19,643,047 pounds of frozen fish was placed in Chicago public cold-storage warehouses, while 20,104,072 pounds were withdrawn during the same period, there being a little over 7,000,000 pounds held over from the previous fiscal year.

The Bureau of Fisheries has also issued economic circulars setting forth the results of similar fish-market surveys in the cities of Louisville, Ky., and Pittsburgh, Pa.

COLD STORAGE FISH.

Apparently there is very little prejudice in Chicago against cold storage fish, and that is as it should be, for it has been shown by investigations of federal bureaus that if fish are frozen soon after landing them from the fishing boats they can be kept frozen for several months in cold storage houses and still reach the consumer in better condition than if delivered direct without freezing.

Very nearly all kinds of fish have their seasons of greatest abundance followed by a period of scarcity. To freeze the fish at times when they are abundant and the markets oversupplied, and carry them over into the period of scarcity, increases their consumption and prevents the dumping of fish which so often happens on account of an oversupply of the market. The fishermen also would get a more nearly just reward for their labor and the public would get its fish at a less price.

The greatest need in the fresh fish industry in California is undoubtedly better freezing and cold storage facilities at the fishing centers. Such plants are being installed very slowly. What is needed to hasten the movement is to convince the public that the fish reach them in better condition if frozen immediately after catching. It will be necessary, however, to freeze the fish immediately after catching, and not after a few days' waiting to find a market, as it must be admitted there is a temptation to do.

CALIFORNIA SARDINES CONSIDERED HERRING BY CHILEAN CUSTOMS OFFICIALS.

The Fish and Game Commission's attention has been called to the fact that the customs authorities of Chile have ruled that California "pound oval" sardines are herring, and propose to collect the \$1.20 per kilo herring rate on importations from California, instead of the 30 cents per kilo sardine rate to which our cannerymen claim they are entitled. The higher herring rate of \$1.20 per kilo, California cannerymen say, will make shipment of our sardines to Chile impossible.

The California sardine is a true sardine scarcely to be distinguished from the sardine of Europe, and should not be confused with the species of herring which are being canned in other places and labeled as sardines. The scientific status of the California sardine and its relation to the other species of sardines and "sardine herrings" is set forth by Mr. Will F. Thompson in the October, 1921, issue of this magazine, in an article entitled "The Sardine of California." It is there shown very clearly that the California sardine (*Sardina coerulea*) is a true sardine. An article to the same effect by Professor E. C. Starks of Stanford University appeared in the April, 1918, number of this magazine.

The Fish and Game Commission is taking the matter up with the Chilean authorities, with the hope that they will give our fish the proper designation of "sardine." At the request of some canners the commission has issued a certificate to the effect that our fish are true sardines and not herring.

WORK OF THE CALIFORNIA LABORATORY OF THE BUREAU OF FISHERIES.

During the past fiscal year, while the Bureau of Fisheries' experimental laboratory at San Pedro was being operated by the Fish and Game Commission, investigations were carried on to determine what changes take place in the "fry bath" oil used for frying sardines. A report on this work is being published by the commission (circular No. 1).

In frying the large sardines for packing in pound cans, as it is practiced in the industry, the fry-bath oil quickly becomes dark in color and imparts a distinct and not altogether agreeable flavor to the sardines being fried. This oil has to be frequently discarded, and on that account contributes very materially to the expense of canning. It was therefore the object of the work at the bureau's laboratory to find some way, if possible, to purify and reclaim this oil and find out what changes caused the peculiar odor and taste in the oil and to devise some way to remedy it.

Several different oils have been used by the industry for frying the sardines, but cottonseed oil is the one commonly used. In the experiments it was found that corn oil or a hydrogenated oil does

equally as well. In regard to the changes which take place in this fry oil, it was found that when fat sardines are fried—and the larger sardines are usually fat—the fry oil in a very short time becomes largely sardine oil. It is the presence of sardine oil in the fry bath which causes most of the trouble it was sought to correct. Sardine oil becomes easily oxidized by heat and contact with the air, and it is oxidized sardine oil which imparts the slight odor and taste to the canned product. No way was found to prevent the sardine oil from getting into the fry oil, and no economical means was found of purifying and reclaiming the fry oil or of preventing the oxidation of the sardine oil in the process of frying. The investigator, Mr. Beard, considers it improbable that any cheap successful means will be found.

The negative results of the experiments in purifying and reclaiming the fry-bath oil forced Mr. Beard to the conclusion that the best way to avoid the disagreeable taste imparted to the sardines and to lessen the cost of packing was to eliminate the process of frying in oil. The work of the laboratory during the present fiscal year has been largely devoted to methods of packing sardines in which oil frying has been eliminated. In these experiments the sardines were precooked in steam and in boiling brine, and they were also packed without precooking. It is believed that a method has been found which will lessen the cost of packing and at the same time result in a better pack, one which will be more palatable and digestible, and will "stand up" in shipping as well or better than the "fried in oil" pack.

The Bureau of Fisheries laboratory has issued pamphlets to California canners describing this method, and sample cans will be furnished to canners if they are interested. The results were given immediately to the canners, so that they might try out the method during the present season.

The California sardine is a very excellent fish and deserves a high place among the canned foods of the United States. It seems necessary, however, that improvements be made in the pound oval pack and that an organized publicity campaign be launched if the California sardine is to win the place in the minds of the people of the United States which it deserves.

LIFE HISTORY NOTES.

LARGE MACKINAW CAUGHT IN
DONNER LAKE.

Anglers in the Truckee basin continue to occasionally catch the mackinaw trout (*Cristovomer namaycush*). On July 26, 1921, Mr. W. B. Gelatt caught a 12-pound

mackinaw trout in Donner Lake, using minnow chubs for bait.

The mackinaw trout was first planted in Lake Tahoe in 1895, and a year later in Donner and other nearby lakes, after the successful hatching of a shipment of eggs.



FIG. 60. Mackinaw trout, weighing 12 pounds, caught July 26, 1921, in Donner Lake by W. B. Gelatt. Mackinaw trout was introduced into the waters of this lake in 1895, but the annual catch is very small.

Although fish of this species are occasionally caught in lakes of the Truckee basin, the mackinaw, or Great Lakes trout, as it is sometimes called, has never thrived to the extent expected when introduced into this part of the country. This season, however, an unusual amount of large trout, ranging from 5 to 15 pounds, have been caught in Donner Lake.—GEORGE NEALE, Sacramento California.

WHITE PELICANS MEET DEATH DURING COLD WAVE.

Investigation authenticated a report in late January that numerous white peli-

cans were found dead on the shores of Lake Washington, near Sacramento. Local observers stated that the extremely stormy weather was responsible for the death of the pelicans. The terrific north wind appeared to render the birds helpless, and many were unable to rise after being blown down on the ice, which was several inches thick, or against wires. After the storm more than twenty-five of the pelicans were found dead along the shore of the lake.—GEORGE NEALE, Sacramento, California.

CONSERVATION IN OTHER STATES.

OREGON KILLS SEA LIONS.

During the past year the Oregon Fish Commission at the request of commercial fishermen, has attempted to exterminate the Stellar sea lions in the colonies along the Oregon coast. For this purpose a special boat was secured and equipped. The slaughter of these mammals is defended on the claim of the fishermen that the sea lions destroy large numbers of young salmon. It is to be hoped that the stomach contents of the animals killed is being carefully analyzed, for when an investigation was ordered a number of years ago here in California, on the complaint of fishermen, the sea lions killed were found to contain squids and octopi rather than salmon.

OREGON HAS ADOPTED NEW GAME CODE.

At the last session of its legislature the State of Oregon adopted a new game code, the outstanding feature of which is the increase in license fees for both hunting and angling to \$3, with the provision that a combination hunter's license and angler's license may be obtained for \$5. With the increased income from license fees the commission expects to improve its patrol service and to increase its hatcheries from five to fourteen.

WISCONSIN'S BUCK LAW FAULTY.

Wisconsin is unfortunate in the wording of her new buck law, which provides that only bucks not less than one year of age can be lawfully taken. As a result sportsmen are continually writing the Conservation Commission, asking for some means of identifying a year-old buck deer. In that according to law a deer can not lawfully be killed until it is one and one-half years old, since fawns are born in May and June, the Conservation Commission has recently instructed its wardens that all deer with horns less than 3 inches in length, found in the possession of a hunter, are fawns and are to be confiscated. An attempt will be made to amend the law at the next legislative session to provide for a certain length of horn.

CONSERVATION IN EDUCATION.

"Education is perhaps the greatest one factor in aiding conservation. Undoubtedly the teaching of the principles of wild-life protection in the public schools will have a wonderful restraining effect upon the coming generation. The Wisconsin Game Protective Association is endeavoring to have a law enacted providing that Wisconsin school children shall be given instruction in the conservation of fish and game as a part of their regular school courses.

An effort should be made in all states by sportsmen's associations to have laws of this nature passed. At the present time Nevada is the only state we know of that has a law requiring that conservation be taught in the public schools of that state." — (R. P. Holland, Field and Stream, May, 1921, Vol. 26, No. 1, p. 33.)

AUSTRALIA ESTABLISHES REFUGE.

The establishment of Wilson's Promontory, a national sanctuary in Australia covering about 101,000 acres of mountainous country, will provide protection

for many birds and become the last refuge for the Lyrebird, which has been so persecuted by the plume-hunter, the egg-collector and the fox.

NATURE PROTECTION IN JAPAN.

Japan is directing her attention very seriously to the protection of her animal life. Certain animals peculiar to Japan are in grave danger of extermination. Such are the Japanese ibis, Japanese egret, the Siberian bustard and the spoon-bill. The Ministry of the Interior of the Empire of Japan has issued a brochure containing a list of the monuments, ruins, sites and places, and of the animal life, which it is desired to protect. — Bird Notes and News, Vol. IX, p. 53.

NEW MEXICO HAS NEW GAME LAWS.

At the last session of the New Mexico legislature the game laws were completely revised and a new commission appointed. The commission is composed of three members, not more than two of whom shall be of the same political party, appointed by the governor. The terms are for six years and are overlapping, so as to assure continuity of policy. The commissioners serve without pay. The chief warden is also appointed by the governor.

The commission is granted regulative powers in addition to those of law enforcement. The new law describes the various functions as follows:

To establish game refuges for the purpose of providing safe sanctuaries in which game may breed and replenish adjacent hunting ranges.

To declare closed seasons in any specified locality on any species of game or fish threatened with undue depletion from any cause.

To purchase land for game refuges and

public hunting grounds, particularly suitable for waterfowl hunting.

To designate resting grounds for waterfowl, in which they shall not be molested.

To close waters to fishing, for the protection of recently stocked streams, spawning waters or depleted waters.

To establish fish hatcheries.

To prohibit hunting in periods of extreme forest-fire danger.

To propagate, purchase and sell game animals, birds and fish for restocking.

To withhold license privileges for not to exceed two years from any person procuring a license through misrepresentation or hunting without a license.

The commission is not authorized to open any closed season established by the legislature, to lengthen any open season, to declare a closed season on any predatory species, or to increase any bag limit.

GAME CONDITIONS IN BRITISH COLUMBIA.

A report of game conditions for 1920 by the Game Conservation Board of British Columbia chronicles several changes in the game laws in an endeavor to better conserve game. In northern British Columbia the bag limit on mountain sheep has been reduced to two rams of any one species or three in all. In the southern part of the province only one ram may be killed. Wapiti are being given a closed season in southern British Columbia. Sentiment favoring a buck law is gaining ground rapidly. Even the grizzly bear is being accorded a measure of protection, being entirely protected south of the main lines of the Canadian Pacific Railway, and a bag limit of three being allowed for the region lying to the north. As might be expected, the catch of fur was comparatively small, the 1842 trappers reporting a take of 110,573 pelts.

REPORTS.

STATEMENT OF EXPENDITURES.

Period July 1, 1921, to December 31, 1921.

Function	Materials and supplies	Salaries and wages	Service and expense	Property and equipment	Total
Administration:					
Commissioners			\$563 33		\$563 33
Executive offices	\$434 54	\$9,376 43	2,931 56	\$12 00	12,754 53
Printing			4,212 30		4,212 30
Research and publicity	242 00	2,050 00	384 01		2,676 01
Accident and death claims			11 28		11 28
Department totals	\$676 54	\$11,426 43	\$8,103 48	\$12 00	\$20,217 45
Commercial fish culture and con- servation:					
Superintendence	\$282 76	\$5,047 50	\$2,711 20	\$373 21	\$8,419 67
Inspection and patrol	2,434 21	10,290 00	2,297 09	33 90	15,055 20
Research	524 20	9,832 67	2,796 19	1,772 28	14,925 34
State laboratory construction	12,779 72	9,855 77	373 32		23,008 81
Statistics	398 00	3,849 49	152 39	184 15	4,584 03
Market fishing license commissions			320 00		320 00
Propagation and distribution of salmon	4,591 14	10,840 12	1,438 42	765 30	17,634 98
Department totals	\$21,010 03	\$49,715 55	\$10,088 61	\$3,133 84	\$83,948 03
Sporting fish culture and conserva- tion:					
Superintendence	\$415 58	\$6,410 41	\$17,824 93	\$28 05	\$24,678 97
General patrol (40 per cent)	356 35	25,686 57	18,711 20	3 88	44,758 00
Propagation and distribution of trout	21,325 55	33,922 48	20,627 43	5,321 39	81,196 85
Department totals	\$22,097 48	\$66,019 46	\$57,163 56	\$5,353 32	\$150,633 82
Game conservation:					
General patrol (60 per cent)	\$559 13	\$38,819 50	\$46,438 04	\$5 82	\$85,822 49
Tahoe camping ground	\$14 55	\$603 00	\$14 75	\$2 50	\$634 80
Grand totals	\$44,357 73	\$166,583 94	\$121,807 44	\$8,507 48	\$341,256 59

Seizures.

Game.

Deer meat	281½ pounds
Deer,	5
Deer	751 pounds
Deer and valley quail	34 pounds
Valley quail	93
Ducks	1,612
Geese	38
Golden plover	1
Spike buck	2
Wild pheasants	3
Meadow larks	7
Swan	1
Sage hens	19
Shore birds	8

Fish.

Abalones	508
Dried abalones	41 pounds
Brant	9 pounds
Bass, black and striped	38
Bass, striped	643½ pounds
Clams	324
Crabs	191
Crab meat	14 pounds
Crawfish	1
Halibut	200 pounds
Croaker—yellowfin	300 pounds
Lobsters	841
Salmon	29
Smelt	75 pounds
Trout	17
Trout	66 pounds
Trout, smoked	50 and 2 boxes

Illegal nets

Searches.

Game

[illegible]

All amounts shown in pounds unless otherwise specified. Albacore and Skipjack cleaned. All other fish in round.

VIOLATIONS OF FISH AND GAME LAWS,

October 1, 1921, to December 31, 1921.

Offense	Number of arrests	Fines imposed
Game.		
Hunting without a license.....	37	\$582 50
Hunting in game refuges.....	8	50 00
Hunting in posted grounds.....	5	85 00
Hunting out of season.....	4	255 00
Trapping without a license.....	2	20 00
False statement to secure license.....	2	50 00
Birds: non-game—possession and killing.....	29	295 00
Deer, male, possession, closed season.....	10	750 00
Deer meat, possession, closed season.....	12	150 00
Does, killing and possession.....	8	500 00
Fawns, killing and possession.....	3	200 00
Doves, killing and possession.....	4	50 00
Ducks, overlimit, possession, killing, closed season.....	10	465 00
Rabbits, possession, killing, closed season.....	6	125 00
Pigeons, possession.....	1	—
Wild pheasants, killing and possession.....	2	50 00
Spike buck, killing and possession.....	3	250 00
Yellow hammers, killing and possession.....	12	30 00
Shore birds, shooting and possession.....	27	200 00
Snipe, killing and possession.....	5	125 00
Paws of bear, possession.....	2	20 00
Wild geese, excess limit.....	2	50 00
Swans, killing.....	1	25 00
Sea gulls, killing.....	1	10 00
Killing game in game refuge.....	3	300 00
Plover, shooting.....	1	66 00
Excess bag limit.....	8	275 00
Shooting from auto.....	3	25 00
Shooting from power-boat.....	12	175 00
Quail, possession, closed season, killing.....	17	350 00
Failure to keep heads and horns in possession.....	1	—
Hides, possession, illegal.....	8	75 00
Night hunting.....	59	1,055 00
Total game violations.....	303	\$6,658 50
Fish.		
Bass, possession, excess limit, undersized.....	18	\$250 00
Crabs, closed season.....	2	15 00
Crab meat, possession, closed season, selling out of shell.....	2	50 00
Abalones, possession, undersized, overlimit.....	12	375 00
Abalones, gathering for profit without license.....	2	—
Crackers, yellowfin and spotfin.....	1	75 00
Crawfish, oversized, buying and possession.....	2	20 00
Halibut, undersized.....	1	25 00
Lobsters, undersized, possession.....	10	165 00
Salmon, overlimit.....	1	100 00
Trout, possession, overlimit, closed season.....	5	225 00
Night fishing.....	20	465 00
Shipping fish by parcel post.....	4	100 00
Fishing without a license.....	10	135 00
Fishing without a license (commercial).....	2	45 00
Fishing within half-mile of spawning station.....	3	60 00
Taking and possession fish within 250 feet of fishway.....	8	75 00
Fishing within 750 feet of wharf.....	1	50 00
Using fence for taking salmon.....	1	25 00
Clams, overlimit, undersized.....	14	395 00
Placing obstruction in stream.....	2	50 00
Discharging sawdust in stream.....	1	50 00
Depositing petroleum in California waters.....	1	—
Allowing dogs to run wild and more than one dog per person.....	3	70 00
Total fish violations.....	121	\$2,820 00
Grand total fish and game violations.....	424	\$9,478 50